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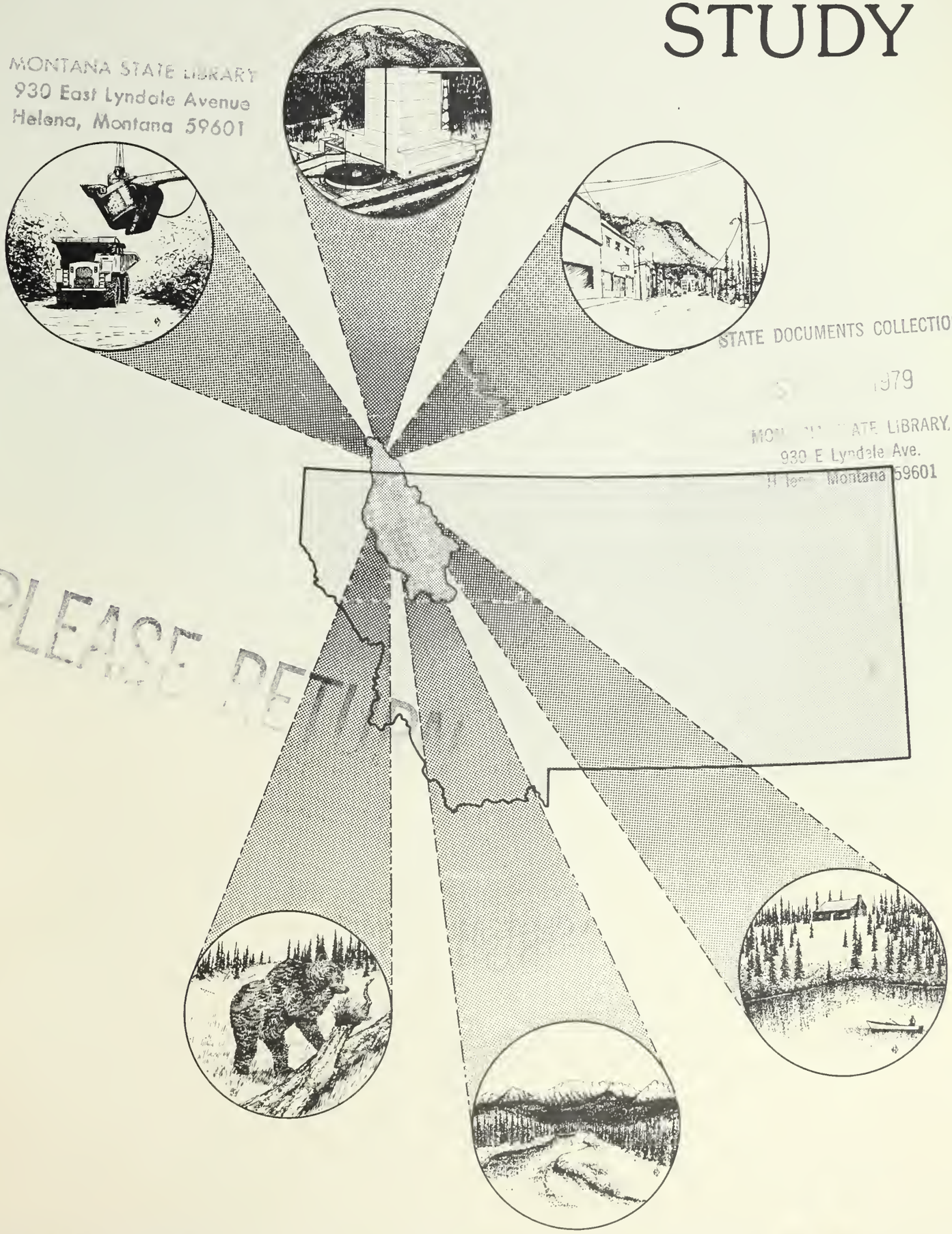

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UPPER FLATHEAD RIVER BASIN STUDY

January, 1977

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Water Resources Division
MONTANA DEPARTMENT OF NATURAL RESOURCES
AND CONSERVATION
Helena, Montana

This study was conducted in compliance with House Bill 622 (1975), using funds appropriated by that bill.

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TABLE OF CONTENTS

Introduction 1

I. The Existing Environment 3

The Physical and Natural Environment 5
- Geology
- Physiography
- Soils
- Climate
- Air Quality
- Water Resources
- Fish
- Other Aquatic Life
- Wildlife
- Vegetation

The Socio-Economic and Cultural Environment 24
- Population
- Economy
- Services
- Housing
- Land Use and Ownership
- Current Water Use and Levels of Need
- Instream Water Use

II. The Proposed Project 33

British Columbia's Guidelines for Coal Development 35

The Proposed Development 35
- The Mining Project
- The Open-Pit Mine
- The Coal Preparation Plant
- Ancillary Facilities

The New Town 43
- Population of the New Town
- Alternative Sites for the New Town

III. Alternative Levels of Future Development 49

Alternative 1: Development of Cabin Creek Coal With a New Town 51

Alternative 2: Development of Cabin Creek Coal With No New Town 51

Alternative 3: No Development of Cabin Creek Coal 52
- Population
- Economy
- Oil and Gas Exploration and Development

IV. Environmental Impacts 57

The Development With New Town Alternative 59
Physical and Natural Environment
Socio-Economic Environment
Legal and Institutional Framework
The Development With No New Town Alternative 62
Physical and Natural Environment
Socio-Economic Environment
Legal and Institutional Framework
The No Development Alternative 65
Physical and Natural Environment
Socio-Economic Environment
Legal and Institutional Framework

V. Summary, Conclusions, and Recommendations 67

Summary and Conclusions 69
The Existing Environment
The Proposed Project
Alternative Levels of Future Development
Environmental Impacts
Recommendations 75

Appendices 79

A. Hydrological and Limnological Data 81
B. Budget Details 101
C. House Bill 622 105
D. Public Law 94-486, The Wild and Scenic Rivers Amendment 109
E. Results of Questionnaire on Water Use 113

Reference Materials 121

Literature Cited 123
Selected Bibliography 128
Glossary 133

LIST OF ILLUSTRATIONS

1. Upper Flathead River Basin 6
2. Wild, Scenic, and Recreational River Designations. 11
3. North Fork Flathead River in British Columbia. 13
4. Artist's Sketch of the Mine Site Before Development. 36
5. Artist's Sketch of the Mine Site After Development 39
6. Roads Which Connect the Mine Site With Existing Service Centers. . 42
7. Alternative New Townsites 46
8. Existing Service Centers in British Columbia 53
9. Flow Diagram of Impact Assessment Required Under HB 622. 70
10. Flathead Lake Sampling Stations. 93
11. North Fork Flathead River Sampling Stations. 99

LIST OF TABLES

1. Flathead River Basin Stream Discharge. 9
2. Stream Migratory Behavior Patterns of Fish in the Flathead River 18
3. Population Distribution Estimates. 25
4. Water Use in Flathead County 29
5. Water Use in the Upper Flathead River Basin. 30
6. Future Water Use in the Upper Flathead River Basin 30
7. Assumptions Used in Predicting New Town Population 45
8. Projected Population Growth in Flathead County 54
9. Estimated Population Influx Into the U.S. Portion of the North Fork. 64

INTRODUCTION

Large amounts of high-grade coal lie along Cabin Creek, a tributary of the North Fork Flathead River, just north of the United States border in Canada. Exploration was begun in 1970 to determine the feasibility of mining this coal. In 1975, environmental and economic assessments were begun for the Canadian government and by the private mining company, Sage Creek Coal Company Limited. This report considers the possibility of impacts to Montana through development of the Canadian Cabin Creek coal.

In 1975, House Bill 622 delegated to the Department of Natural Resources and Conservation the responsibility of conducting a study of the upper portion of the Flathead River drainage and northern portion of Flathead Lake for the biennium ending June 30, 1977. Details of the budget are shown in appendix B. This study report is designed to fulfill the following four tasks presented in the law (Montana Session Laws 1975):

1. Compile and analyze all previous biophysical data pertinent to the hydrology and limnology of the northern portion of Flathead Lake and the upper portion of the Flathead river drainage basin.

2. Estimate current allocations and levels of need for the water resources of this watershed and evaluate the probable effect that the existing water uses have upon the quality and quantity of water as well as the biophysical equilibrium of the land-stream-lake system.

3. Evaluate as a function of location and time the probable impact upon the land-stream-lake system of the development of the Canadian Cabin Creek coal deposits and the attendant urbanization of this headwaters region, as well as the impacts arising from changes in domestic land-use and flood control.

4. Synthesize data and contain a summary report and recommendations for the future.

The law emphasizes that impacts to Montana from Canadian Cabin Creek coal development are to be evaluated. Consequently, the emphasis of this study is on environmental systems receiving direct impacts. Therefore, the study is directed at the North Fork Flathead River from the Montana-British Columbia border to its confluence with the Middle Fork Flathead, the mainstem river from the North Fork confluence to Flathead Lake, and all of Flathead Lake.

The law identifies the upper portion of the Flathead River Basin and the northern portion of Flathead Lake as the area of study. This area was expanded to include all of Flathead Lake because of the difficulty of segregating hydrological and limnological data from portions of the lake. The expanded study area has frequently been referred to as the Upper Flathead River Basin and will be referred to as such in this report.

PART I

THE EXISTING ENVIRONMENT

In the Department's investigation, it became evident that some possible effects of mining Cabin Creek coal may be widespread in the Upper Flathead River Basin, and that others may be restricted to the North Fork Valley. In the discussion which follows, various environmental concerns are analyzed. Only those geographical areas which are expected to receive significant impacts are discussed.

THE PHYSICAL AND NATURAL ENVIRONMENT

The Flathead River is a tributary of the Clark Fork in northwestern Montana (figure 1). If the outlet of Flathead Lake at Polson is considered to be its mouth, the Upper Flathead Basin is 7,096 square miles in area. Approximately 427 square miles (6%) of that lies in British Columbia. The remainder lies almost entirely in Flathead and Lake counties, with small portions of the headwaters in Missoula, Powell, Lewis and Clark, and Lincoln counties.

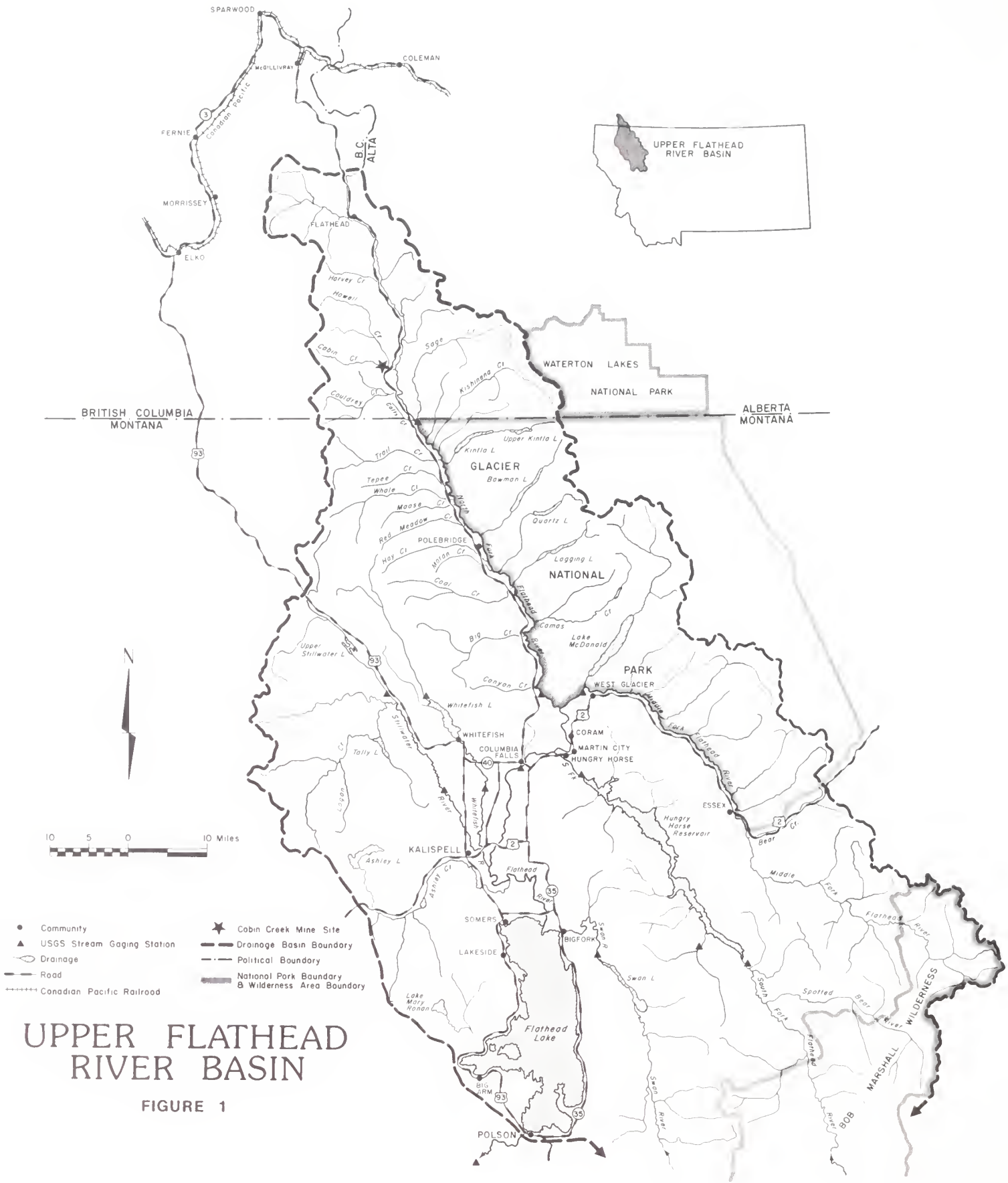
Geology

The trench-like depression between Columbia Falls and Flathead Lake, known as the Kalispell Valley, was initiated by down-faulting during late Paleocene-Eocene time (65 to 55 million years ago). Approximately 50 million years ago, materials began eroding from nearby mountains and were deposited in the valley. These sediments were reworked during Pleistocene time (nearly 2 million years ago) and buried beneath glacial deposits. With the retreat of the last glacial stage, Flathead Lake expanded northward, inundating the Kalispell Valley. As the outwash sediments from receding glaciers continued to accumulate, the lake level lowered; and the Flathead River and its tributaries entrenched their courses about 100 feet into the consolidated valley-fill deposits. The river and its tributaries have continued to mature, creating broader flood plains and more gentle gradients.

Physiography

The Upper Flathead Basin consists of a series of northwest-trending mountain ranges with interfingered tributaries of the Flathead River. This basic form was initiated by a broad regional uplift, combined with faulting about 60 to 70 million years ago, and has remained essentially unchanged to the present. The valley of the North Fork is typical; a glaciated valley about eight miles wide, it is bounded on the east by the Continental Divide and on the west by the Whitefish Range, both northwest trending.

Rocks from the Precambrian Belt Series outcrop on the mountains, which average slightly over 7,000 feet (but extend to 10,000 feet) in elevation. Tertiary age sediments eroded from the mountain ranges fill the intermontane valleys (3,000 to 4,000 feet in elevation). These sediments, however, are extensively covered by glacial deposits related to ice from the Pleistocene Ice Age which persisted perhaps as recently as 10,000 to 13,000 years ago in this area.



UPPER FLATHEAD RIVER BASIN

FIGURE 1

Glaciation has slightly modified pre-existing land forms in many ways. Glacier Park, which is partially drained by the Flathead, is internationally known for its u-shaped valleys, cirque basins, horns, and other glacially induced features. While many scenic features have been sharpened by ice in the higher elevations of Glacier Park and adjacent mountain ranges, lower elevations have inherited a more subdued topography. Where ice overrode lower elevations, high places were scoured and rounded while low spots accumulated deposits carried in and beneath the ice. This so-called "knob and kettle" topography is present in many areas that were beneath the ice. Flathead Lake, as it existed originally, was backed up behind terminal moraine deposits which accumulated at the southern end of the ice advance. Glacial outwash, glacial deposits reworked and resorted by glacial meltwater, underlies the majority of the area in the Flathead Valley and forms floodplains and terraces adjacent to the Flathead River and its tributaries.

Soils

Soils in the Upper Flathead tend to be immature or incompletely developed due to their relatively recent disturbance by glacial ice. A major exception is evidenced in the relatively productive alluvial soils developed from outwash deposits on the floodplain and terraces of the Flathead River.

Soils on mountain slopes and narrow valleys tend to be rocky, thin, and nutrient poor; they are often unstable on steeper slopes if vegetation is removed. These soils, which tend to predominate in the North, South and Middle fork valleys, support a luxuriant coniferous forest, where drainage and depth are suitable. This is possible because of abundant precipitation and because of the low nutrient requirements of conifers. Mountain soils have relatively low value as agricultural soils.

Soils in the relatively flat portion of the Flathead Valley north of Flathead Lake are generally of two types. One type, underlain by unsorted glacial till (the residual material left when glacial ice melts), is generally rocky and poorly drained. This soil is marginally used for agriculture but more extensively managed for timber production.

The other valley soils, underlain by deposits that have been reworked or sorted by running water, are the most productive soils in the area and are managed extensively for cultivated crops. These are generally deep, well-structured, and well-drained but often require fertilizer to maintain nutrients in the soil.

Climate

The climate of the basin may be classified as a Pacific maritime type modified by local influences and winter, polar continental air masses spilling westward over the Continental Divide, bringing brief periods of continental-type winter weather. Climatic variations in the basin can be as extreme as its rugged terrain. To the south, Flathead Lake, elevation approximately 2,900 feet, has a moderating effect on the climate around its shores, bringing cooler temperatures in the summer and warmer temperatures in the winter. Fruit growers around the lake depend on this microclimate for a longer growing season and warmer springtime temperatures. To the north and east, mountain ranges in

Glacier National Park and along the South and Middle forks of the Flathead River create an air lifting-cooling effect. The mountains sometimes receive several hundred inches of snow annually. Runoff from late-season snowmelt provides high stream flows in spring.

Air Quality

Within the Upper Flathead River Basin, ambient air and meteorological data are being collected by the Montana Department of Health and Environmental Sciences (MDHES 1976a) in the Kalispell-Columbia Falls area. This data collection is oriented primarily towards existing Kalispell-Columbia Falls point-source type pollutant sources. Measurements in 1975 and 1976 at several locations around Columbia Falls have indicated particulate levels in excess of both federal and state ambient standards and fluoride levels in excess of state ambient standards (MDHES 1976a, and J. W. Gelhaus, MDHES to Gerald Mueller, Montana DNRC; personal communication, November 9, 1976, Helena). Meteorological data collection has only been recently initiated, and data are not yet available.

Water Resources

The basin has an average annual runoff at Polson of 8,549,000 acre-feet, approximately 20 percent of Montana's average annual runoff flowing from only four percent of Montana's land surface. The major tributaries to the Flathead River are listed in table 1, along with their corresponding streamflow-gaging stations, period of record, drainage area, and average annual runoff.

Ground Water

The relationship of ground water to surface water in the Flathead River system in northwestern Montana is that common to many intermontane basins. Streams in these basins can be influent (losing water to the ground-water system) and/or effluent (gaining water from the ground-water system). Although no conclusive data exists, it is assumed that the Flathead River has both relationships along its course.

The valley of the North Fork is made up of four geohydrologic units; 1) recent floodplain and alluvial deposits left by the North Fork and tributary streams, 2) deposits associated with the latest glacial movements, 3) tertiary sediments generally older than the glacial material, and 4) the Precambrian rocks which produce water from fractures. Of these, the most potentially valuable for water use are the recent alluvial deposits of the North Fork. At present, the department has on file 17 appropriations from this aquifer, 12 from springs, and five from wells. The water quality in the alluvial aquifer adjoining the river is very good, meeting federal drinking water standards (U.S. Department of Health, Education, and Welfare 1962). The water is of a calcium bicarbonate type. Because of the apparent close relationship in this area between the stream levels and ground-water levels, there should be a close hydrologic connection between the two. The water quality in the stream could then be a factor in the water quality of the aquifer. If the water

TABLE 1

FLATHEAD RIVER BASIN STREAM DISCHARGE

Tributary-Gaging Station	Years of Record[a]	Drainage Area (in square miles)	Average Flow (in cfs)	Average Annual Runoff (in acre feet)
Flathead River-B.C.	23	427	992	718,700
N. Fork Flathead River-Columbia Falls	43	1,548	3,023	2,190,000
M. Fork Flathead River-Essex	22	510	1,067	722,500
M. Fork Flathead River-W. Glacier	35	1,128	2,971	2,152,000
S. Fork Flathead River-Hungry Horse	17	958	1,935	1,401,000
S. Fork Flathead River-Hungry Horse	10	1,160	2,429	1,760,000
S. Fork Flathead River-Columbia Falls	46	1,663	3,583	2,596,000
Flathead River-Columbia Falls	46	4,464	9,814	7,110,000
Stillwater River-Whitefish	22	524	343	248,500
Whitefish River-Kalispell	23	170	193	139,800
Ashley Creek-Kalispell	19	195	30.8	22,310
Swan River-Bigfork	52	671	1,163	842,600
Flathead River-Polson	67	7,096	11,800	8,549,000

SOURCE: U.S Department of Interior 1974a

[a]Years of record are not the same or there is not a continuous period of record for all stations; some stations are not shown; records are as of 1974.

quality in the stream is poor, and the stream is influent, the water quality in the aquifer could be degraded because the aquifer would be accepting poorer quality water as recharge.

Portions of the Kalispell Valley support heavy ground-water development. Most valley reaches of the mainstem Flathead are gaining water from the ground-water system as described in Bulletin 68 of the Montana Bureau of Mines and Geology (1968). Because of this gain, little effect should be noted on either the quality or quantity of ground water in the valley.

Middle Fork Flathead River

Quantity. The Middle Fork Flathead River originates in the Bob Marshall Wilderness area and flows northwestward for over 100 miles, joining with the North Fork about four miles upstream from the town of Hungry Horse. The river drains an area of over 1,130 square miles and has no impoundments on the mainstem or its tributaries. The river from east of Essex to West Glacier forms the southern boundary of Glacier National Park. It is classified under the National Wild and Scenic Rivers Act of 1968 as a wild river from its headwaters to Bear Creek, a distance of 46.6 miles and as a recreational river from Bear Creek to its confluence with the South Fork, a distance of 54 miles (figure 2).

Quality. The water quality of the Middle Fork Flathead River is presently very good. Water quality samples collected near Bear Creek and above reflect natural conditions due to the lack of man's activities upstream. During the high flows of spring, relatively heavy sediment loads are carried down river. During the June 1964 flood, the river undercut steep walls of glacial materials, causing slides which are still contributing to the turbidity of the spring flows.

Man-caused water quality degradation has occurred mainly because of logging practices and road construction, individual sewage systems, and one treated sewage discharge to Lake McDonald from Lake McDonald Lodge. The Lodge is soon to be connected with the Apgar treatment facilities, which will eliminate this discharge.

South Fork Flathead River

Quantity. The South Fork Flathead River also originates in the Bob Marshall Wilderness and is over 100 miles in length. It flows northwestward 60 miles through a broad, glaciated valley to Hungry Horse Reservoir, an impoundment about 50 miles in length. The reservoir has a storage capacity of 3,468,000 acre-feet for electrical generation and flood control purposes. The river flows about five miles from Hungry Horse Dam to its confluence with the mainstem of the Flathead River, about two miles below the town of Hungry Horse. The river, which drains over 1,600 square miles, is classified as a wild river from its headwaters to Spotted Bear River, a distance of 51.3 miles, and as a recreational river from Spotted Bear River to Hungry Horse Reservoir, 8.8 miles (figure 2).

FIGURE 2

WILD, SCENIC, & RECREATIONAL RIVER DESIGNATIONS

Wild

Scenic

Recreational

Quality. The South Fork Flathead River above Hungry Horse Reservoir has been slightly influenced by road construction and logging. Like the Middle Fork, the South Fork has a natural fluctuation of turbidity levels depending on flow volume. However, because of Hungry Horse Reservoir, turbidities from upstream are rarely observed below the reservoir, due to the settling effect of the reservoir and the low placement of the discharge structure in the dam. The clay component of the suspended sediments is important in settling out nutrients such as phosphorous through sorption (Tibbs et al. 1975). Hence, the settling effect of Hungry Horse Reservoir could assist in slowing the rate of eutrophication of Flathead Lake (MDHES 1976b).

The low placement of the discharge structure in Hungry Horse Dam causes the withdrawal of water from the lower strata of the reservoir pool where lower water temperatures and chemical properties are relatively constant, unaffected by seasonal fluctuations. These factors, combined with the daily changes in releases for power demand, have had a limiting effect upon the biota (Stanford 1973), most notably upon the migrational and spawning habits of the fish in the mainstem Flathead River (Montana Department of Fish and Game (MDFG) 1976).

North Fork Flathead River

Quantity. As stated in the introduction, this report will emphasize the North Fork of the Flathead, the river most likely to be affected by coal development. The North Fork originates in the Canadian Rocky Mountains and flows southward, draining 389,000 acres of British Columbia. Flathead Provincial Forest makes up 85 percent of this area; another 13 percent is Park Reserve land adjacent to Waterton Lakes National Park in Canada; the remaining two percent consists of private land holdings scattered along the river. The most outstanding physiographic feature of the alluvial plain which forms the Flathead Valley floor in British Columbia is the downcut trench occupied by the North Fork which has cut banks up to 200 feet tall. Tributaries such as Howell, Cabin, and Couldrey creeks to the west of the river and Sage and Kishinena creeks to the east (figure 3) contribute to the North Fork's annual flow of 718,700 acre-feet at the border, one-third of the annual North Fork flow measured near Columbia Falls.

The North Fork crosses the British Columbia-Montana border and meanders through a broad, glaciated valley until it reaches Big Creek, about 43 miles south. From Big Creek to its confluence with the Middle Fork (15 miles), the river flows through a relatively straight, alluvial trench. The 23-year average annual flow near the confluence with the Middle Fork is 3,023 cubic feet per second (cfs). Maximum discharge during the period of record 1935-74, occurred on June 9, 1964, and was 69,100 cfs; the minimum discharge, 198 cfs, occurred on January 8, 1953. During average flows the river channel varies in width from 100 feet at the border to 300 feet at the confluence with the Middle Fork. The North Fork has been classified as a scenic river from the border (40.7 miles) to Camas Creek and as a recreational river from Camas Creek to its confluence with the Middle Fork (17.6 miles)(figure 2).

The North Fork flows 58.3 miles from the border to the Middle Fork and drains over 1,121 square miles of land in the U.S.

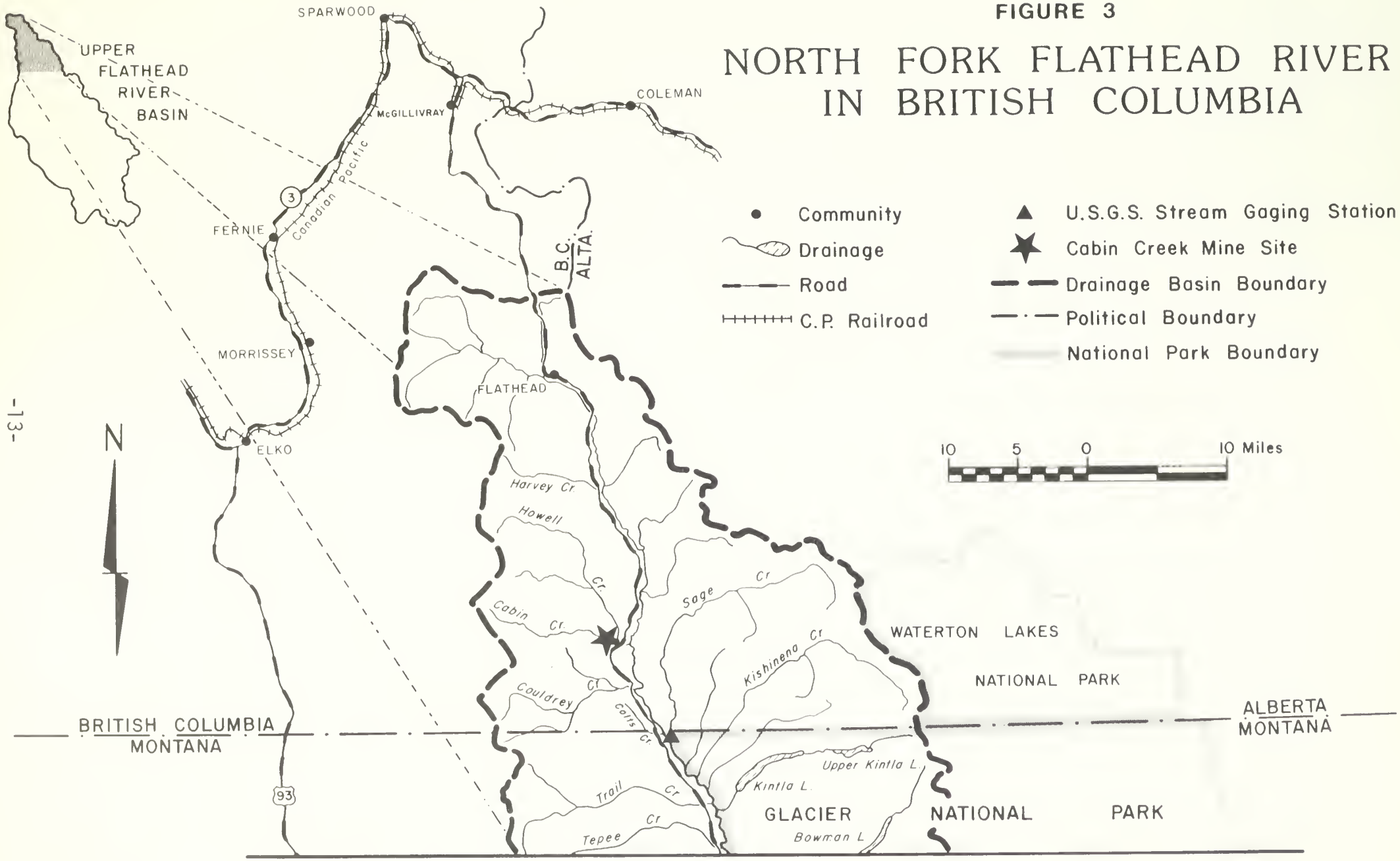


FIGURE 3
NORTH FORK FLATHEAD RIVER IN BRITISH COLUMBIA
Community
Drainage
Road
C.P. Railroad
U.S.G.S. Stream Gaging Station
Cabin Creek Mine Site
Drainage Basin Boundary
Political Boundary
National Park Boundary
10 5 0 10 Miles
N
UPPER FLATHEAD RIVER BASIN
SPARWOOD
McGILLIVRAY
COLEMAN
FERNIE
Canadian Pacific
3
MORRISSEY
ELKO
93
B.C.
ALTA.
FLATHEAD
Harvey Cr.
Howell Cr.
Cabin Cr.
Sage Cr.
Kishinena Cr.
Couldrey Cr.
Collis Cr.
Trail Cr.
Tepee Cr.
Upper Kintla L.
Kintla L.
Bowman L.
WATERTON LAKES NATIONAL PARK
GLACIER NATIONAL PARK
BRITISH COLUMBIA
MONTANA
ALBERTA
MONTANA

Quality. Water quality is excellent for the North Fork above the confluence with the Middle Fork. Dissolved oxygen, pH, bicarbonate, and alkalinity values from previous studies indicate the stream has a low organic content and mildly alkaline, bicarbonate-type water. Other chemical parameters had low values and are typical of aquatic ecosystems which are deficient in plant nutrients (oligotrophic) and thus are biologically unproductive (see appendix A).

Water temperatures varied from near freezing to 60.8^{o}F. Turbidity, total suspended solids, organic color, and total dissolved solids were usually low although turbidity increased during spring runoff.

Total organic carbon was not detectable, and total and fecal coliform counts were low.

Nutrient concentrations were moderately low, usually at or below detectable limits. During spring runoff total phosphorus, usually below detectable limits, occurred at higher (although still moderately low) concentrations, possibly as a result of logging in the North Fork drainage.

Dissolved silica occurred in high enough concentrations to promote diatom growth.

Tests made for the presence of 17 metals indicated that most were not detectable. Chromium, cobalt, manganese, strontium, and aluminum were detectable, but their concentrations would not cause any known problems, given the other conditions in the system. Iron and copper were also detectable; one out of nine samples showed iron concentrations high enough to cause staining and precipitation problems in domestic water supplies.

No pesticides were detected.

Mainstem Flathead River

Quantity. The mainstem of the Flathead River flows over 30 miles from the confluence of the North Fork and Middle Fork to its entrance into Flathead Lake, flowing most of that distance through the broad Kalispell Valley from just above Columbia Falls to Somers. Running in a north-south direction, this intermountain basin is about seven miles wide at the south end and as much as 15 miles wide in the central and northern part. The topography of the valley reflects the most recent glacial recession and the meanderings of the Flathead River. Above Kalispell, the river has a gradient of about six feet per mile; below Kalispell, it decreases to about one foot per mile during minimum impoundment of Flathead Lake.

The Flathead River flows 71.5 miles beyond Flathead Lake to its confluence with the Clark Fork. Any impacts of upstream development on this lower reach of the river were not included as part of this study.

Quality. The Flathead mainstem, like the North Fork, is low in organic content and has mildly alkaline, bicarbonate-type water.

Below the mouth of the Middle Fork, water temperatures are kept lower than for the North Fork due to year-round releases of 39°F water from Hungry Horse Reservoir.

Turbidity, total suspended solids, organic color, and total dissolved solids were low, as for the North Fork.

Other chemical parameters were reduced 13 percent in value from the North Fork to the mainstem, apparently the result of dilution.

The total organic carbon value and total coliform count were low while the fecal coliform count was four organisms per 100 ml as compared to one for the North Fork. This higher count is probably the result of discharges from three municipal sewage plants and runoff from livestock yards between Columbia Falls and the Bigfork sampling station (appendix A).

Nutrient levels were generally low except for slightly higher phosphorus levels during spring runoff. The mainstem has slightly lower total phosphorus (as PO_4) concentrations than the North Fork, suggesting that the North Fork supplies more than its proportional share of the downstream phosphorus.

Metals concentrations were below detectable limits.

Other Major Streams

Quantity. The Stillwater and Whitefish rivers both originate along the western edge of the basin and flow southeastward to their confluence and eventual drainage into the Flathead River near Kalispell. Both are considerably smaller tributaries than the three forks of the Flathead, the Stillwater having an approximate drainage area of 525 square miles and the Whitefish draining about 170 square miles. The surrounding geographic land forms are typified by gentle rolling hills and broad alluvial valleys. Both drainages have either natural or manmade impoundments on their mainstems and have more sluggish flows in their lower reaches.

Quality. The water quality of the Stillwater and Whitefish rivers is influenced by agricultural and logging activities. The Stillwater River yields high withdrawals for agricultural irrigation, from both the river and nearby ground-water aquifers. These withdrawals create such low summer flows that barriers to fish migration exist (MDHES 1976). Seasonal erosion, agricultural and logging activities, and treated sewage effluent from the Whitefish city treatment plant all contribute to the degradation of the water quality of the Whitefish River (MDHES 1976).

The Swan River originates between the Swan Range and the Mission Mountains Wilderness southeast of Flathead Lake and flows northward. West of and parallel to the South Fork of the Flathead River, the Swan flows through Swan Lake and Bigfork Dam before entering Flathead Lake at Bigfork. It is nearly 80 miles in length and drains over 670 square miles of mountainous country.

The water of the Swan River is of such high quality that the town of Bigfork obtains its entire water supply directly from the river. Moderate to

heavy logging activity and limited subdivision siting have had surprisingly low impact on the river, thus far. Migrating fish from Flathead Lake are seriously restricted from using the Swan River because of a poorly constructed fish ladder at the diversion dam near the Bigfork power plant.

Flathead Lake

Quantity. Flathead Lake is the largest body of fresh water west of the Mississippi River and covers over 126,000 acres. The lake is 28 miles long, with an average width of 6.5 miles and a maximum depth of 362 feet. The lake has a capacity of 1,219,000 acre-feet; the upper ten feet of the lake has been regulated since 1938 by Kerr Dam, south of Polson. Kerr Dam has an installed electrical generation capacity of 168 megawatts and is also operated for flood control.

Quality. Many studies of the lake's water quality have been conducted since it was first classified as an oligotrophic mountain lake (Howard 1929, Young 1935). Investigators still classify it as oligotrophic (MDFG 1976, Tibbs et al. 1975), but some feel there may be a trend towards increased nutrients such as ammonia, nitrate, and ortho-phosphate (Seastedt and Tibbs 1974).

Dissolved oxygen levels are high and fairly constant throughout the lake. The water is slightly alkaline, well buffered and moderately hard.

High turbidity values in May and June are a result of high spring runoff. An interface develops between warmer, turbid river water and the colder, clear lake water so that mixing occurs slowly. Surface waters are generally clear again by early August (Seastedt and Tibbs 1974).

Nitrate values were generally low; higher values occurred during spring and fall turnover when mixing of the lake's thermally stratified waters occurs.

Phosphorus is the limiting factor to algae growth in the lake. If the phosphorus level increased and if the nutrient was able to be utilized by algae and other aquatic life, there would be an increase in lake producitivty. Since suspended clay particles absorb some of the phosphorus and then sediment out, the actual rate of eutrophication is slower than would be predicted from total phosphorus values (Seastedt and Tibbs 1974).

Silica and total carbon values and metals concentrations in the lake are low.

Fish

The fishery resource of the Upper Flathead River basin has developed through the adaptation of natural and introduced species to an ecosystem based on cold, clear waters of low productivity. This fishery is dependent upon the entire Flathead River-Lake system which functions as a complete ecological unit. The headwater tributaries provide necessary spawning and nursery areas while the lake provides a more abundant source of food for faster growth and adult development. Without the tributaries or access to them through the main rivers, the lake populations would diminish to a very

small number and conversely, without the lake there would be much smaller and fewer fish in the tributaries.

The construction of Hungry Horse Reservoir has blocked 60 percent of the migratory spawning runs from Flathead Lake (Stanford and Schumacher 1976). Today, the North Fork and its tributaries comprise an estimated 40 percent of the spawning and nursery habitat for migratory fish.

Ten of the 19 fish species now living in the lake are considered native to the drainage. Some of these indigenous game species are the westslope cutthroat trout (Salmo clarki), the Dolly Varden (Salvelinus malma), and mountain whitefish (Prosopium williamsoni). In the early 1900's, 13 exotic species were introduced, and nine of the species continue to survive. Brook trout (Salvelinus frontinalis), rainbow trout (Salmo gairdneri), lake trout (Salvelinus namaycush) and kokanee salmon (Oncorhynchus nerka) are some of the introduced game species that make a major contribution to the sport fishery resource (MDFG 1976).

There are three classifications which have been established according to the behavior patterns of the fish species in the drainage. Most Dolly Varden, westslope cutthroat, kokanee salmon, and some mountain whitefish are classified as adfluvial. They live their adult lives in the lake and migrate into smaller tributaries to spawn. Fluvial populations of Dolly Varden, westslope cutthroat trout, and mountain whitefish live their adult lives in larger streams and move into smaller tributaries to spawn. After the young hatch, they may stay in the smaller tributary from one to three years before migrating to the larger stream. Some westslope cutthroat and mountain whitefish live their entire life cycles, including spawning, in a small segment of a lake or stream and are termed resident fish. Table 2 presents a generalized overview of the fish species and their classifications.

Tagging programs were initiated in 1955 by Block to analyze distributional aspects of the various migratory species and continued by the Montana Department of Fish and Game until 1965. The westslope cutthroat trout and Dolly Varden were the main species of concern.

The westslope cutthroat trout is a highly specialized species which has adapted to the cold water temperatures and limited food supply of the Flathead River-Lake ecosystem. Westslope cutthroat are not known to enter spawning tributaries until minimum daily water temperatures exceed 40°F. Adfluvial races are known to travel as far as 80 miles upstream for spawning. Once hatched, the pre-smolts spend two years in the small tributaries beginning migration in the third summer. By late fall or early winter, the smolts enter the lake for maturity. The westslope cutthroat has an average life expectancy of six years, probably making no more than two spawning runs during its lifetime.

The Dolly Varden, locally known as bull trout, displays the same interdependent relationship between the lake and river system as the westslope cutthroat trout. The Dolly Varden has migrated as far as 120 miles to reach spawning beds in the Middle and North Fork Flathead Rivers. They spawn in the early fall to avoid extremely low winter water temperatures.

TABLE 2

STREAM MIGRATORY BEHAVIOR PATTERNS OF FISH
IN THE FLATHEAD RIVER

Species	Resident Stream Races	Adfluvial Races	Fluvial Races
Dolly Varden	yes	yes	yes
Westslope cutthroat trout	yes	yes	yes
Mountain whitefish	yes	yes	yes
Brook trout	yes	limited	yes
Kokanee salmon	no	yes	no
Rainbow trout	yes	no	no
Lake trout	no	no	no

SOURCE: Montana Department of Fish and Game 1976, p. 6, table 2.

Nutritional relationships and quality and quantity of spawning habitat are poorly documented. The Montana Department of Fish and Game began a long-range study of these elements in the spring of 1976 for the North Fork drainage. Introduced into the drainage in the 1920's, the rainbow trout is known to hybridize with the westslope cutthroat trout. They spawn at similar times and in similar areas where running water flows over and through gravelly river bottoms. Hybridization, however, is very limited, and the range and distribution of the rainbow trout has not increased significantly in the past 20 years. Small isolated populations remain where daily low water temperatures in the spring spawning season are warmed by lake discharges.

First introduced into Flathead Lake in 1916, the kokanee salmon has increased in importance as a sport fish since. Kokanee begin migration into the lower Flathead River system from the lake in late July. Spawning runs continue through mid-December with the emergence of fry in late March and April of the following year. Kokanee salmon are a land-locked form of the Pacific sockeye salmon and also die after spawning. The presence of Hungry Horse Dam has increased river runs for spawning. Warmer water temperatures from the reservoir during the critical first few weeks of egg development have increased survival rates of kokanee fry in the river. However, the reservoir has had a negative effect on kokanee fry production in the mainstem Flathead River when discharge flows were at a minimum, leaving spawning beds dry. The annual mid-winter drawdown of Flathead Lake has also reduced spawning success along the east and west shorelines. Kokanee salmon have provided approximately 75 percent of the fishery in Flathead Lake, not including the special snagging season every fall during spawning runs.

The 19 species of fish in Flathead Lake are found in different habitats. The majority of bottom fish (whitefish, Dolly Varden, and lake trout) prefer a zone eight feet above the bottom. Rough fish (northern squawfish, peamouth, and suckers) are also associated with the bottom but are rarely noticed in waters deeper than 60 feet and never in deeper waters than 90 feet. Westslope cutthroat trout are associated with the surface zone or in areas where waters

are less than 30 feet deep. Kokanee display the widest habitat range of all species, preferring a fluctuating zone which is dependent on temperature and light and is constantly changing with seasonal and daily variations. Other physical parameters directly influencing the fish in the lake are river and lake currents and unnatural lake level manipulation.

The fluctuating discharges of constant cold water temperatures from Hungry Horse Reservoir have altered downstream hydrologic characteristics and associated fish habits. Cutthroat trout are known to false start their spawning runs up the river in the spring when reservoir discharges warm up the daily temperatures above 40°F. They return to the lake when they reach natural temperatures below 40°F.

The westslope cutthroat trout are probably the most sensitive of all trout in the drainage to chemical and sediment pollution. Fish planting tests with adult hatchery cutthroat trout have produced poor results. If the native species was lost to the drainage, it is doubtful an introduced species could replace it.

The North Fork Flathead River has a low buffering capacity with which to protect against potential toxic material contamination (appendix A). Introduction of concentrations of decaying organic material and/or sulfuric acid from oxidized pyrites, sulphides, and sulphates could increase carbonic acid (H_2CO_3) concentrations, thus lowering the pH. This could then cause larger quantities of toxic metallic ions to go into solution. Aquatic insects are very sensitive to toxic metallic ions, but of greater significance is the accumulation of these ions in fish. While toxicity levels may be acceptable for water quality or drinking water standards, they may be excessive because of accumulation in the fish.

The Flathead River-Lake fishery is totally dependent upon natural reproduction in the tributaries and the lake. Any direct effect to one of the parts of the system, would have a direct effect on the entire system.

Other Aquatic Life

Investigations of aquatic insects have been limited to extensive studies of the order Plecoptera (stone flies) by Stanford (1975). Recent unpublished reports by Sonstelie (1967) and Potter et al. (1975) have discussed the aquatic invertebrate communities found in certain segments of the Flathead River and Lake ecosystem. In addition, the Flathead Drainage 208 Project has recently collected quantitative data on aquatic insects in the North Fork Flathead River and its west slope tributaries.

Aquatic insects such as caddis flies (Trichoptera), mayflies (Ephemeroptera) and midges (Chironomidae) are known to be abundant, but detailed studies have not been conducted.

Forty-two plecopteran species have been identified in the Flathead River with the greatest species diversity observed just above Kalispell on the Flathead mainstem. Diversity was slightly less in the North and Middle forks.

Species composition of plecopters in the South Fork below Hungry Horse Reservoir has been drastically altered by discharges from the lower, colder portion of the reservoir. Only five species with reproducing populations have survived these discharges, and the effects of the discharge have been noted as far downstream as the mouth of the Flathead River.

Stone flies have annual life cycles which are sequenced and synchronized according to thermal variations in the water, while size and species diversity is determined by quality and quantity of food and microhabitats.

Flathead Lake supports over 600 species of phytoplankton and a diverse community of zooplankton. Diatoms comprise the majority of the phytoplankton with maximum numbers of "blooms" occurring in early May, corresponding to high concentrations of nutrients with phosphorus as the limiting factors.

Zooplankton graze on the smaller phytoplankton and appear to be less influenced by the chemical and physical properties of the lake.

Wildlife

The wide variety of habitats of the Upper Flathead River Basin supports nearly all species of animals found in northwestern Montana west of the Continental Divide (see Skaar 1975, Parratt 1974, Lechleitner 1955, and Singer 1975c for a listing of birds and mammals known from the area). Certain of the many wildlife species which inhabit the area are of special concern; these include: (1) species which are particularly vulnerable to disturbance, (2) important game species, (3) and species which are rare, threatened, or endangered. The U.S. Bureau of Sport Fisheries and Wildlife, in its 1973 "Red Book," has identified certain species of animals as endangered (in danger of extinction in all or part of their range), threatened (so few in numbers or threatened by present circumstances as to be in danger of extinction), and status-undetermined (possibly in danger of extinction but not sufficiently well-known to determine actual status). Although the classifications reported in the Red Book have been supplanted by the Endangered Species Act of 1973, they are nevertheless useful in determining which species of the Upper Flathead River Basin are of special concern. These species will be discussed in more detail below.

Bird Species of Special Concern

The great blue heron (*Ardea herodias*) which subsists largely on fish, crustaceans, frogs, and other aquatic organisms, is closely dependent upon wetland habitats, and is seldom found far from water areas or marshes. Nesting takes place in large colonies (often having 100 or more nesting pairs) which are very sensitive to harassment or other disturbance. Numerous colonies are found on the islands and shores of Flathead Lake, and within the cottonwood forests of the Flathead River itself, particularly below Columbia Falls.

The bald eagle (*Haliaeetus leucocephalus*) feeds almost entirely on fish, and hence is closely tied to water areas. As many as 400 or more bald eagles congregate in fall and early winter along lower McDonald Creek and the Middle Fork of the Flathead River, where they feed on spawning kokanee salmon; this is one of the largest concentrations of bald eagles in the conterminous

United States (McClelland 1973, Shea 1973). Eagles are found in smaller numbers throughout the basin in fall and winter. While very few bald eagles remain in Montana to breed, at least five active or recently active nests are known within the Upper Flathead River Basin.

The osprey (Pandion haliaetus) like the bald eagle, feeds almost exclusively on fish, and is dependent upon lakes and larger rivers for its food supply. Although populations have declined drastically in the eastern and mid-western United States (Henny and Ogden 1970), a fairly large number of osprey nest throughout the Basin, with the greatest densities being found along the Flathead River below Columbia Falls and along the shores of Flathead Lake (Koplin et al. 1970). The osprey is classified as a status-undetermined species.

There are no known active eyries in Montana but the endangered peregrine falcon (Falco peregrinus) may pass through the Flathead Basin during migration. A small number of prairie falcons (Falco mexicanus), listed as threatened, pass through the basin during migration, but none are known to breed in the area.

The long-billed curlew (Numnius americanus), merlin (Falco columbarius), and ferruginous hawk (Buteo regalis) are grassland birds whose status is undetermined. The curlew may breed in the lower Flathead Valley, the merlin may breed in montane grasslands, and nesting has not been confirmed for the ferruginous hawk.

Mammal Species of Special Concern

Once considered extinct in Montana, the endangered gray wolf (Canis lupus) persists in very low numbers at the northern edge of Glacier Park and in a few other areas of the state (Singer, 1975d).

The black bear (Ursus americanus) is widely distributed in relatively small numbers throughout the coniferous forests of the Upper Flathead River Basin. Several studies of black bear within the Basin (Jonkel and Cowan 1971; Tisch 1971) have shown the spruce-fire/queencup beadlily forest type (which includes spruce-fir/myrtle pachistima types) to be an important habitat at all seasons; snowslides and meadows are used heavily in spring, while spruce-fir/menziesia and spruce-fir/beargrass associations become increasingly important in late summer and fall. The black bear is currently classified as a big game animal.

Small numbers of the threatened grizzly bear (Ursus arctos) are found within the Basin, where they inhabit coniferous forests, ridgetops, and meadows. Grizzlies are known to concentrate on the valley floor of the North Fork Flathead River during spring and fall, where they feed upon roots, tubers, forbs, and rhizomatous grasses in wet meadows of the floodplain. The summer months are usually spent in high forests, cirques, and slides, where huckleberries, serviceberries and small mammals provide the bulk of the diet (Singer 1976, Martinka 1971, 1972, 1974b).

Portions of the Basin have been proposed as critical habitat for grizzly bears by the Director of the U.S. Fish and Wildlife Service (Federal Register 41(215):48757-59; November 5, 1976). Grizzly populations and their habitat

are currently being studied through the Border Grizzly Project, under the direction of Dr. Charles Jonkel.

The fisher (Martes pennanti), once extinct from Montana, has been reintroduced into the Upper Flathead River Basin, and a small population exists there today in climax and near-climax coniferous forest habitats (Weckwerth and Wright 1968). This rare furbearer has been classified as a status-undetermined species by the U.S. Bureau of Sport Fisheries and Wildlife (U.S. Department of Interior 1973).

The marten (Martes americana), a furbearer classified as a status-undetermined species (U.S. Department of Interior 1973), is widespread in the high coniferous forests of the Basin. Mature forests of spruce and subalpine fir are the preferred habitat of the marten, which subsists largely on rodents, especially voles (Koehler et. al. 1975).

Wolverines (Gulo gulo) were nearly exterminated from Montana in the early 1900's, but have successfully reoccupied much of their former range as a result of dispersion from remnant populations in Canada and Glacier Park. They now occur in small numbers in remote coniferous forests, semi-open subalpine regions, and alpine tundra within the Basin. A study of this fur-bearing mammal, which is also classified as status-undetermined, is currently underway within the Basin. (Newby and Wright 1955; Hornocker and Hash 1974).

The mountain lion (Felis concolor), an uncommon game animal, inhabits remote mountainous areas within the Basin; and occasionally wanders through agricultural or even residential areas. Resident populations probably occur in the Basin wherever deer and elk, the major prey species, are abundant.

A rare inhabitant of coniferous forests within the Basin, the lynx (Lynx canadensis) is dependent upon populations of the snowshoe hare as a food supply. The lynx was classified as a status-undetermined species by the Bureau of Sport Fisheries and Wildlife (1973).

The elk (Cervus canadensis), perhaps the most important big game species in the Basin, is widely distributed throughout remote mountainous areas, and appears to be the most abundant big game animal in the upper North Fork drainage. Grasslands are an important habitat at all seasons. Forests and wet meadows at higher elevations are used in summer and fall; migration to south-facing grassland slopes, seral shrubland, and lodgepole pine savannah at lower elevations occurs with the heavy snows of autumn. Elk congregate on these restricted winter ranges throughout winter and spring. Grasses constitute the bulk of the spring and fall diet, while forbs are most important in summer and browse is heavily used in winter (Singer 1975a, d, Martinka 1974a).

Although less abundant than white-tailed deer or elk, mule deer (Odocoileus hemionus) are a locally important big game species in the Upper Flathead River Basin. Mule deer are migratory, moving from high-elevation summer-fall range to river bottoms and grasslands which are occupied in winter and spring. Diets are variable, but browse is the most important forage class during winter.

White-tailed deer (Odocoileus virginiana) are abundant in the Basin, and are one of the most important big game species. Grasslands are preferred during spring and fall; forests of Douglas fir and spruce, as well as riparian

cottonwood forests, are important during other times of the year. Browse is the preferred forage class during all seasons except spring, when forbs are of greatest importance (Martinka 1970; Singer 1975a, c). While part of the population is resident in river bottoms and lower-elevation forests, seasonal migrations do occur.

Moose (Alces alces) are widespread throughout the Basin, occupying moist coniferous forests and adjacent willow bottoms and river flood plains yearlong. Browse, particularly willow and dogwood, is preferred forage, and accounts for nearly all of the winter diet. Moose constitute a relatively small proportion of the annual big game harvest (Schladweiler 1974; Singer 1975c).

Native mountain goat (Oreamnos americanus) populations are found within the Basin in the Swan and Flathead Mountains and in the high peaks of Glacier Park. Preferred habitat generally contains steep, rugged cliffs and alpine tundra, although forests are occasionally used enroute to natural mineral licks. Grasses, sedges, rushes, and forbs are important forage sources year-round; browse may be important in winter. (Chadwick 1973, Rideout 1974, Singer 1975b).

Bighorn sheep (Ovis canadensis) occur in relatively small numbers in the Swan Range and Glacier Park within the Upper Flathead Drainage Basin. High-elevation grasslands are preferred summer-fall habitat; snow-free grassy ridges with nearby cliffs providing escape terrain are characteristic of winter ranges (Couey and Schallenberger 1971; Singer 1975b).

Vegetation

The Upper Flathead River Basin includes a wide variety of vegetation types, reflecting the variability of physiography, climate, and substrates found within the Basin. In the following discussions, the major natural vegetation types occurring within the Basin will be described. Information on forest habitat types is based on the reports of Bigler and On (1974) and Pfister et al.(1974).

While most of the Flathead River Valley south of Columbia Falls has been cultivated, some natural grasslands remain, particularly on south-facing foothills and the lower slopes of mountains. At lower elevations, these are usually dominated by bunchgrasses such as bluebunch wheatgrass; higher grasslands, including grassy mountain parks, are typically dominated by fescues.

The Flathead River floodplain supports extensive forests dominated by cottonwoods and often including Engelmann spruce and Rocky Mountain juniper. The understory generally contains abundant shrubs, such as willow, alder, red-osier dogwood, chokecherry, silverberry, and hawthorne.

Streambanks and valleys in the higher mountains often support a dense shrubland dominated by willow, alder, and aspen and bordered by birches or conifers.

Ponderosa pine dominates the lowest forest zone in the Basin, often occurring on drier sites as scattered trees or groves of trees interspersed with grassland, corresponding to the ponderosa pine/bluebunch wheatgrass habitat type of Pfister et al. (1974).

Forests occurring on somewhat more moist sites are dominated at climax by Douglas fir, and include the Douglas fir/snowberry and Douglas fir/pinegrass habitat types. These typically occur on south slopes, and are of high to moderate productivity. Western larch and lodgepole pine occur as early successional dominants; seral shrublands within these types are important as winter ranges for elk and deer.

Subalpine fir and Engelmann spruce dominate extensive areas in the higher mountainous areas of the Basin; the predominat habitat types are subalpine fir/queencup beadlily, subalpine fir/menziesia, subalpine fir/beargrass, and spruce/twinflower. Subalpine fir/woodrush and subalpine fir/devil's club also occur to a limited extent. The subalpine fir/queencup beadlily habitat type, found on cool, moist foothills, terraces, and valley bottoms, is one of the most extensive in the Basin and is also highly productive.

Small areas of the western hemlock/queencup beadlily and western red cedar/queencup beadlily habitat types occur near the mouth of Cedar Creek and along adjacent drainages. These are among the most productive habitat types in the area, and include a variety of timber species, including western larch, white pine, Engelmann spruce, grand fir, lodgepole pine, and Douglas fir in addition to western hemlock and western red cedar.

Dense stands of lodgepole pine, most dating from the extensive fire activity of the early 1900's, cover large areas throughout the mountainous portions of the basin. Most stands are probably seres of spruce-fir or Douglas-fir habitat types.

Forests of subalpine fir and whitelark pine are found on high, wind-swept ridges and form the upper timberline on the highest peaks of the Basin. These are of exceptionally low productivity and are generally not considered commercial forest types.

Peaks above timberline, particularly in Glacier Park, are above the cold limits of trees and are characterized either by steep scree or talus slopes, nearly devoid of vascular vegetation, or by an association of low mat-forming alpine plants.

THE SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT

Even without Canadian Cabin Creek coal development, the Upper Flathead River Basin, now one of the fastest growing areas in the state, will continue to grow. Flathead County population statistics (U.S. Department of Commerce 1970) show a sixty-three percent increase in population from 24,271 persons in 1940 to 39,460 persons in 1970.

Population

The basin's high quality environment attracts thousands of vacationers every year. With Glacier Park, Flathead Lake, and the three forks of the Flathead River, outdoor recreational opportunities abound in the area. This pursuit of recreation has contributed to almost a doubling of the county's population since 1940, and a current growth rate of approximately 1,500

persons per year. Flathead County is one of the few in Montana with a recent history of growth. The Flathead County Areawide Planning Organization (1976) has estimated the county's population at 48,127 persons for 1976. Of this total, the three largest incorporated communities--Kalispell, Whitefish and Columbia Falls--are estimated to contain 36 percent of the population. Individual estimates for each community, each community's jurisdictional area (community plus the surrounding outlying suburbs), the county jurisdictional area (area dependent on county services but outside community jurisdictional areas), and total county populations are given in table 3.

The population of the surrounding suburban areas of the three primary service centers will soon surpass the population of their incorporated communities. The Kalispell jurisdictional area in 1976 already exceeds 20,000 persons, approximately 9,000 of whom live in the outlying suburbs such as Evergreen. The Whitefish suburbs have the highest growth rate in the county at 16 percent.

TABLE 3

POPULATION DISTRIBUTION ESTIMATES

Area	1970	1974	1976
City of Kalispell	10,526	10,559	10,936
Kalispell Jurisdictional Area	NA	19,278	20,360
City of Whitefish	3,349	3,381	3,539
Whitefish Jurisdictional Area	NA	6,313	6,939
City of Columbia Falls	2,652	2,977	3,185
Columbia Falls Jurisdictional Area	NA	5,160	5,485
Flathead County Jurisdictional Area	NA	13,736	15,343
TOTAL COUNTY POPULATION	39,460	44,487	48,127

SOURCE: Flathead County Areawide Planning Organization 1976, pp. 2 and 3.
NA = Not Available

The county jurisdictional area is estimated to exceed 15,000 persons in 1976, an 11 percent increase over 1974.

The North Fork drainage was first opened for homesteading in 1914. Recreational opportunities of the basin have established a summer resident population of about 200 persons, while year-round or permanent residents are estimated to number approximately 30 persons.

Economy

In terms of personal income and earnings, Flathead County was the sixth largest county in Montana in 1974 (Montana Department of Community Affairs 1976).

Personal income has increased by 65 percent over the past 20 years. This growth rate, greater than that of most counties in Montana, has fluctuated substantially from periodic increases, such as construction of Hungry Horse Dam, and depressions, such as closure of lumber mills. While personal income has increased, Flathead County ranks only fifteenth in Montana as to the level of family income. High areawide unemployment rates of 7 to 9 percent annually and 12 to 14 percent seasonally have contributed to low levels of family income. The high demand for jobs by people attracted to the area, the seasonal nature of tourist trade, and fluctuations in the timber industry result in high unemployment.

The economic structure of the county can be divided into two classifications--basic and derivative industry. Basic industries are those which bring in dollars from outside the county, e.g., tourism, the lumber industy, and Anaconda Aluminum Company. Derivative industry,which derives its existence from the basic industry, consists of local services and retail trade, e.g., hospitals, service stations, and shopping centers.

In a recreational area such as Flathead County, a minor percentage of the derivative industry comprises part of the basic industry, such as tourists trading at retail shops and foodstores. A ratio of these two economic classifications displays the balance of the economy of an area. Flathead County has a historical derivative to base ratio of 2.24:1, or 2.24 derivative jobs to each basic industry job.

Economic growth in the various industrial sectors of Flathead County, from 1970 to 1974 has been extensive. Manufacturing (36%); wholesale, and retail trade (21%); government (18%); transportation, communication, and utilities (11%); and finance, insurance, and real estate (3%) represented the leading sectors of the county economy.

The wholesale and retail trade sector has fluctuated throughout the past. In 1974 it represented the second largest sector of the county's economy at 21 percent. Employment has been increasing in this sector as Kalispell has increased in importance as the area's regional retail trade center. In 1967, Kalispell accounted for over 50 percent of the retail stores in the county and over 68 percent of the retail sales. Since then, the percentage of sales has decreased while the number of businesses has stabilized. Many Kalispell businesses have followed national trends by relocating or opening branch offices in the surrounding suburbs.

Kalispell is expected to continue its role as the regional retail trade center in the future. Local and regional residents are expected to increase utilization of local retail stores because of the variety of selection and increased number of services located in one community. The tourist trade accounts for a large portion of the retail trade, and this sector is also expected to increase.

The economic base of the North Fork drainage has centered on timber and forest products sales activity on U.S. Forest Service lands and some agricultural production, such as grazing of grass-fed beef cattle. Some coal mining for local consumption took place in the Coal Creek area until the late 1930's. The grade of coal proved to be so low that mining on a large scale was not economically feasible.

The transportation, communication, and public utilities sector has declined for the past twenty years. Earnings have decreased from 17 percent of the county's economy in 1950 to 11 percent in 1974, and employment has declined to six percent of the total labor force. The importance of the railroad industry has been declining. Glacier International Airport provides commercial flights to major terminals throughout the west and midwest. Expansion of the airport facility is planned for the near future.

The finance, insurance, and real estate sector of the county economy, though sensitive to fluctuations in national interest rates and inflation, has remained at a stable three percent among total earnings and total employment. Real estate development has increased throughout the county with the increasing demand for second home development; however, increases have only kept pace with the remainder of the economy.

Real estate and land sales are increasing in importance as a source of earnings in the North Fork drainage. Since 1960, over 3,600 acres, 16 percent of the private land, has been subdivided. Most of the lots are being sold for development of summer or vacation residences.

The services sectors of the county economy have increased in earnings over the past twenty years, but the percentage of total earnings among sectors has remained relatively constant at 12 percent. Employment has increased both in number and among other sectors to 12 percent. Recent developments include the construction of a new hospital and doctors' offices, expansion of the new community college, and an ever increasing school enrollment. Kalispell is becoming more widely known as a convention center as hotel and motel facilities increase.

Services

The North Fork drainage lacks most of the modern amenities presently available throughout the rest of the county. Polebridge, an unincorporated community, offers the only services available in the area. A combination mercantile and tavern offers a few food and retail items, gasoline, and telephone service.

Other services, such as police and fire protection, utilities, schools, and churches, are not available in the drainage; the nearest access to these services is in Columbia Falls.

Housing

Housing availability in the North Fork drainage is limited to individual

development for personal needs on private lands. Presently, additional housing is not available. An immigration of summer residents has necessitated construction of new private dwellings where existing dwellings were not available.

A small number of rental cabins are available in the Polebridge area and are already used extensively during the summer months and hunting season.

Land Use and Ownership

Fifty-three percent of the North Fork Valley is to the east of the river, in Glacier National Park. The western half of the valley is divided among private land holdings (7% or 22,520 acres), federal land (88% or 284,140 acres) managed by the U.S. Forest Service, and state land (5% or 17,750 acres) managed by the Forestry Division of the Department of Natural Resources and Conservation. The government lands have been managed primarily for forest products and recreational use. Private lands have historically been used for timber production and scattered cattle grazing. Over 17.5 percent (3,941 acres) of the private land has been subdivided.

The beauty of the Livingston Range in Glacier National Park and the relatively wild nature of the drainage has attracted increased recreational use. Glacier Park attracted 1,571,393 tourists during the summer season of 1975, an increase of 11.7% over 1974 (Lee Forman, Glacier National Park to Hanley Jenkins, Montana DNRC; personal communication, December 8, 1976, West Glacier). Current recreational uses in the North Fork drainage include rafting, hiking, camping, horseback riding, fishing, hunting, snow skiing, snowmobiling, and sightseeing.

On October 12, 1976, Senate Bill 1506 was signed into law (90 Stat. 2327) which amended the Wild and Scenic Rivers Act (82 Stat. 906; 16 U.S.C. 1271 et seq.) by adding the North Fork from the Canadian border downstream to its confluence with the Middle Fork as well as other portions of the Flathead River, to the Wild and Scenic Rivers Act. Development of a management plan for the designated reaches of the Flathead must be completed by the Forest Service, U.S. Department of Agriculture by October 12, 1977. Appropriation of funds in the amount of $6,719,000 for acquisition of lands and interests in lands in all reaches of the designated portions was also included in the legislation with no funding available prior to October 1, 1977.

The administration of the Wild and Scenic Rivers in the valley is the responsibility of the Forest Supervisor, Flathead National Forest. A management plan will be developed by 1977 to guide the administration of the river resource. The plan will coordinate resource uses, land uses, recreational activity and other uses to benefit future activities. There would be no restrictions made on private land under this plan unless the right to make these restrictions has been acquired under the provisions of the law.

Current Water Use and Levels of Need

Consumptive Water Use

Total water use in Flathead County has been estimated (MDNRC 1975) for

irrigation, municipal, rural domestic, livestock, and industry uses (table 4).

TABLE 4

WATER USE IN FLATHEAD COUNTY

	Gallons Per day	Acre-Feet Per Year
Irrigation[a]		129,800
Municipal	5,293,000	5,930
Self-Supplied Industry	4,518,000	5,060
Rural Domestic	1,962,000	2,200
Livestock	380,000	420
TOTAL	12,153,000	143,410

SOURCE: Montana Department of Natural Resources and Conservation 1975, p. 10, table 3 and unpublished data.

[a]Because of the nature of irrigation practices, a gallons per day figure is not given.

Of the water use illustrated in table 4, a minor amount is used directly from the North Fork and mainstem Flathead rivers. No towns use Flathead River water and only Somers withdraws municipal water from Flathead Lake. Somers uses an estimated 85 million gallons (260 acre-feet) per year. About 17,315 acres of land are irrigated from the Flathead River, using an estimated 43,288 acre-feet of water per year. Rural domestic and livestock water use is minor, although it is the major water use along the North Fork. At least 798 families withdraw drinking water directly from the river or the immediate alluvial aquifers. There is no major industry using surface water in the basin, but the Anaconda Aluminum Plant at Columbia Falls does withdraw ground water from wells located near the river.

During the months of July and August 1976, to satisfy the requirements of HB 622, a survey was made of landowners along the North Fork and mainstem of the Flathead River above Flathead Lake (appendix E) to determine the amount of water used from both surface and ground-water sources and the uses to which the water was applied. Prior to this survey, little was known about individual water use in the basin either present or anticipated. The results are presented in table 5.

The water use survey also attempted to project water needs into the future. Of the 415 replies received, 117 persons indicated an anticipated increase in future water use from the Flathead River system. This future water use is shown in table 6.

Any future increase in population in the basin would require additional supplies of water. For domestic users, 50 gallons per person per day is considered adequate. If development of community services and commercial enterprises is involved, another 150-200 gallons per person per day may be required. Water for livestock and rural domestic uses is presently obtained primarily from ground-water wells, so there would be little impact upon these uses from anticipated changes in the surface water system.

TABLE 5

WATER USE IN THE UPPER FLATHEAD RIVER BASIN

	Gallons Per Day	Acre-Feet Per Year
Irrigation[a]		43,288
Municipal	171,900	192
Self-Supplied Industry	27,456	31
Rural Domestic	1,068,700	1,197
Livestock	85,566	96
TOTAL	1,353,622	44,804

[a]Because of the nature of irrigation practices, a gallons per day figure is not given.

TABLE 6

FUTURE WATER USE - UPPER FLATHEAD RIVER BASIN

Year	Additional Amount of Water Required (in acre-feet)
1977	10,578
1978	11,140
1979	121
1980	6,388
1985	322
1990	28
2000	202

Instream Water Use

Instream uses of water are those which do not require removal of the water from the source of supply. Two instream uses are especially important in the Flathead Basin--recreation and fish and wildlife conservation. Unlike consumptive water uses, instream uses can be served simultaneously by the same water, provided necessary water quality standards are met.

Instream uses of water do not easily lend themselves to quantitative measurement. They are, however, of great importance and have considerable influence on the quantity and quality of water available for consumptive uses.

Recreation users and fish and wildlife all make substantial use of the Flathead River and its tributaries. Many Montanans and many out-of-state tourists recreate on or near these streams and the associated lakes and reservoirs. The Montana Fish and Game Department (Schumacher 1976) estimated that the fishery resource in the study area provided over 200,000 man-days of fishing in 1968 and 250,000 in 1975. The river is also used extensively for floating, canoeing, and kayaking.

Determination of instream flow requirements for aquatic life are under development and will assist in documenting the need for water for this use. Most of these instream uses could not exist if it were not for good water quality. Although they have not been adequately measured or estimated, the uses are of major significance both now and in the future.

PART II

THE PROPOSED PROJECT

BRITISH COLUMBIA'S GUIDELINES FOR COAL DEVELOPMENT

The British Columbia Environment and Land Use Committee requires all new coal mining enterprises to follow the Guidelines for Coal Development (1976). The guidelines require the mining company to complete a four-stage project assessment process. The first step of assessment requires the filing of a Prospectus. The Prospectus contains a general outline of the proposed exploration and mining programs. The second step or Stage I report assesses the purpose and nature of the project proposed and the present state of the environment, and identifies people who may be involved and further areas needing study. The Stage II report presents a more detailed assessment of the project and identifies some impacts. The Stage III report discusses the operational plans and the applications for the necessary permits for development.

THE PROPOSED DEVELOPMENT

The Sage Creek Coal Company Limited submitted the Preliminary Environmental Impact Assessment of the Proposed Sage Creek Coal Project, Stage I Report in July 1976 (Hinton, B.R., and Associates Limited et al 1976a). The following description of the proposed development is summarized from that report.

The Mining Project

The East Kootenai region in the southeastern corner of British Columbia has been recognized as an area rich in coal since the late 1800's. Coal was first reported in the North Fork Flathead River Basin in 1910. However, serious attempts to extract these reserves were not made until the late 1960's. At that time, licenses were obtained to explore and develop coal deposits in the Canadian Cabin Creek area of the Basin (figure 4).

Exploration of the licensed area led to the joining of Pan Ocean Oil Limited (40%) and the Rio Algom Limited (60%) to form Sage Creek Coal Company Limited in September 1970. The completion of exploration activity in 1975 identified a calculated economic coal reserve of 132 million tons situated in two hills north and south of the valley of Cabin Creek (figure 4). The North Hill is estimated to contain reserves of 81.4 million tons, while the South Hill is structurally more complex with estimated reserves of 51.3 million tons.

The Cabin Creek coal reserves were formed during the late Jurassic and/or early Cretaceous period. Four economically significant seams are identified in the Kootenai Formation. Exploration discovered a coal of medium volatile bituminous ranking with 0.5 percent sulfur content and 25 to 35 percent ash content. Sulfur and ash content are similar to that found in eastern Montana reserves, but a comparison of BTU ratings shows the high quality Cabin Creek coal reserves at 14,000 BTU's per pound while eastern Montana reserves average 7,600 BTU per pound. The metallurgical grade of this coal makes it more valuable as a coking coal for the making of steel than as fuel for thermal-electric generation facilities.

FIGURE 4

ARTIST'S SKETCH OF THE MINE SITE BEFORE DEVELOPMENT

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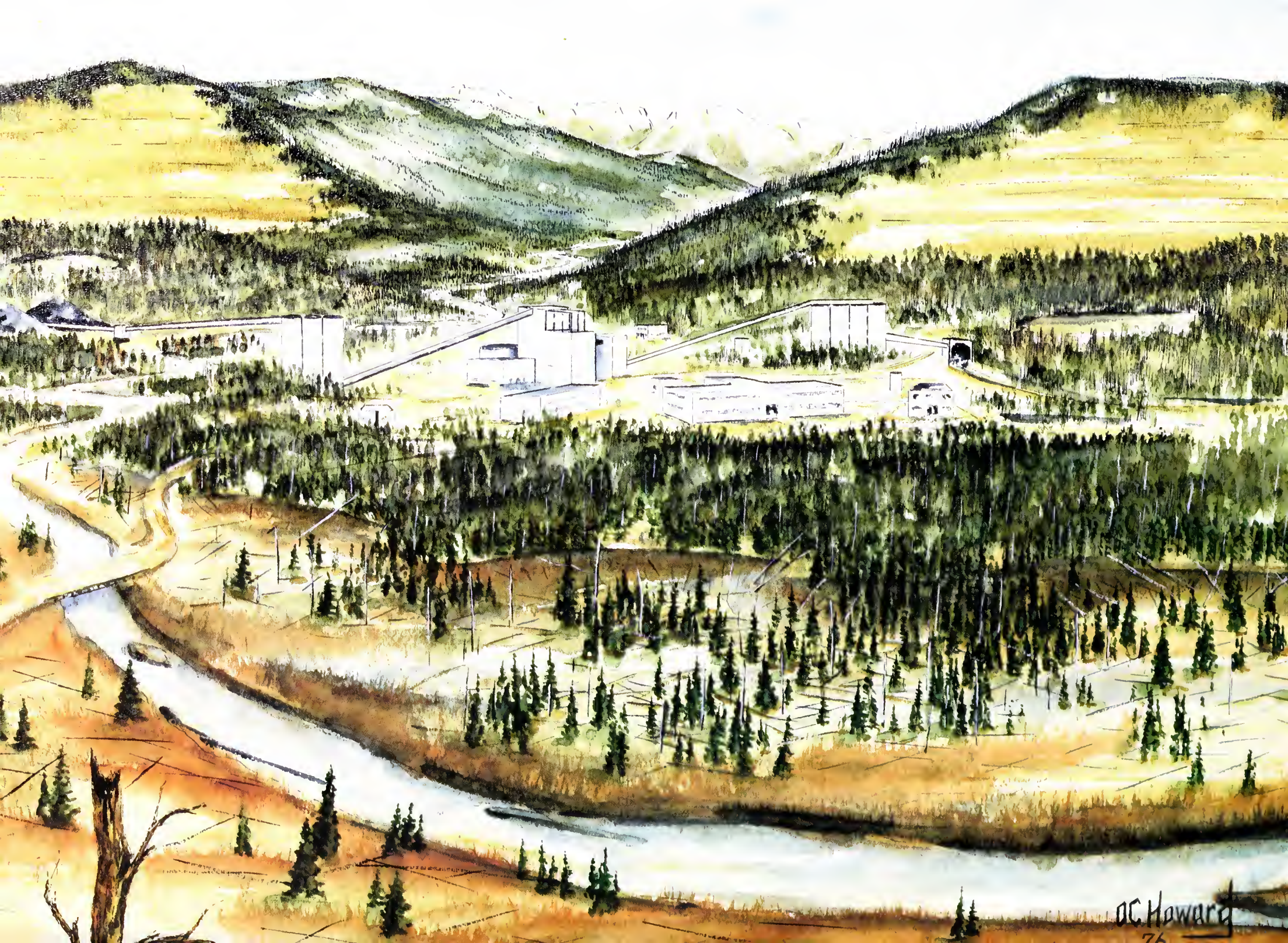
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FIGURE 5

ARTIST'S SKETCH OF THE MINE SITE AFTER DEVELOPMENT

The Open-Pit Mine

The mining method intended for the extraction of the Cabin Creek coal is commonly known as "open-pit mining." Similar to strip mining, in which the surface overburden is stripped away from horizontal beds of coal, open-pit mining strips away the surface overburden to get at coal seams dipping at an angle. The Cabin Creek coal seams have an easterly dip plunging toward the Flathead River at approximately 30 degrees. Therefore, mining will require the removal of the eastern face of the North and South Hills (figure 5).

The Stage I report emphasized that mining will begin on the North Hill because the coal seams are uniform overall. Once the North Hill excavation has progressed below the valley floor, mining will commence on the South Hill. Both hills will be mined until the below-grade portion of the North Pit is no longer economically minable; then total coal production will come from the South Hill until the completion of the project.

Waste rock from the North Hill will be relocated north of the mining area where Howell Creek presently flows. For every long ton of raw coal mined in the North Hill, an excavation of 11.7 cubic yards of rock is required. This will create a waste dump of 954 million cubic yards, and once the rock is excavated, it will increase in volume by 25 percent, demanding an area of 1,360 acres. A new hill will be created in the valley which will be keyed to the existing North Hill.

The composition of the waste materials in the North Hill is comprised predominantly of sandstones and shales with glacial drift and alluvial deposits near the surface. While these materials are not chemically toxic, they will erode once disturbed.

The company has outlined plans to establish a series of ditches and dikes around the discard and mining areas to divert run-off into a system of settling ponds before being released into Cabin Creek.

Reclamation of the excavation and discard areas is planned to recontour and revegetate the slopes for wildlife habitat. The discard areas will be established with an overall slope of 26 degrees. Areas between terrace benches may have slopes in excess of 30 degrees. Success with revegetation of slopes at this steep an angle is questionable.

The disposal of the discard materials from the North Hill will require the diversion of Howell Creek to the east of its present channel, eliminating the existing confluence with Cabin Creek. A study of the proposed Howell Creek diversion was prepared for the company in July 1976. Four alternative diversion routes were identified, but only one was recommended. The suggested route proposed to recreate a natural stream. The design of the diversion takes into consideration hydrologic needs, aquatic habitat, and fish passage.

Waste rock from the South Hill is planned for temporary disposal in a hollow on the north slope of the South Hill just south of Cabin Creek. Once the excavation of the North Hill is completed, the bulk of the South Hill

waste rock will be backfilled into the North Pit. For every long ton of raw coal mined from the South Hill, an excavation of 11.9 cubic yards of waste rock is required. A discard area of 740 acres is required to dispose of 610 million cubic yards of waste rock from the South Hill. The total disposal area necessary for 156.4 million cubic yards of waste rock and 40.2 million cubic yards of plant refuse in the North and South Hill is 2,100 acres.

The composition of the waste rock in the South Hill is complex. The South Hill has ten known faults which dissect the underlying formations. Discard materials, as for the North Hill, are comprised primarily of sandstones and shales interspersed between the coal seams with glacial drift and alluvial deposits covering the surface. One deviation from the North Hill materials was the discovery of bentonitic clay in the South Hill during exploratory drilling.

The discard areas for the South Hill waste rock will be terraced with ditches and dikes at their bases, much the same as the North Hill discard areas. Runoff will be diverted to the settling ponds before being discharged into Cabin Creek. Plans are to convert the excavated South Pit into an artificial lake once mining is completed. The lake would act as a settling pond until revegetation stabilized the mining area.

Artesian aquifer conditions in the North and South Hills were encountered during the 1975 exploration program. Unconfined ground water is also anticipated to be abundant. Excavation of these aquifers will necessitate pumping of the open pits. A discharge of 4.5 cfs from the pit areas to the settling ponds is expected. This water is void of oxygen and, if discharged directly into Cabin or Howell creeks, could cause undersaturation. Conversations with mine personnel in October 1976 noted that the ground water has high phosphorus levels.

The Coal Preparation Plant

An onsite coal preparation plant is planned to process the raw coal. The marketable coal will be separated from the refuse using a closed cycle washing system. Plans are to dry the preparation plant refuse. The refuse will then be mixed with waste rock at a 1:40 ratio (every unit of refuse will be mixed with 40 units of waste rock) and disposed of in the discard piles. The plant will require approximately 2 cfs for the washing operation. This water will be obtained from the 4.5 cfs discharged from the open pits, reducing the total discharge from the open pits to the settling ponds to 2.5 cfs. No discharge of processing waters is planned from the plant to surface water sources.

Ancillary Facilities

Access Roads

The mine will require construction of mining and access roads. The mining roads will be used primarily by mine haul trucks for the transport of raw coal and waste rock. Runoff from the mine roads is planned to be connected to the system of ditches and dikes used for the mine and discard areas.

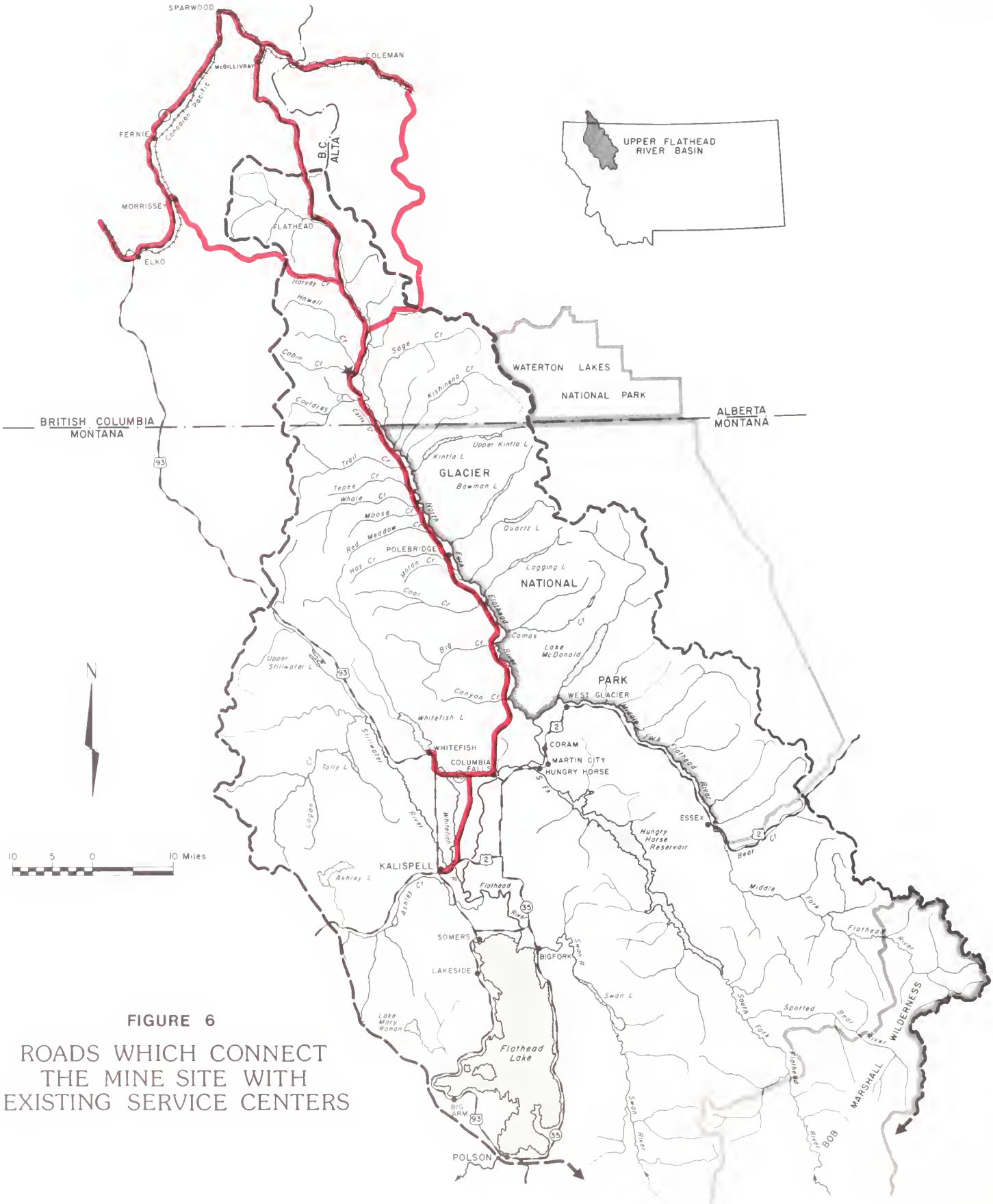


FIGURE 6

ROADS WHICH CONNECT THE MINE SITE WITH EXISTING SERVICE CENTERS

Four unpaved roads currently access the mine site to existing communities, shown in figure 6. At this time, none of these roads are capable of supporting the amount of traffic that would be generated from the mine and its accompanying community. The mine will necessitate the up-grading of an existing road to an all-weather, paved surface with access to an existing service center.

Company personnel in October 1976 identified the primary access road as the Morrissey route which connects with British Columbia 3 at Morrissey. The Morrissey route covers the shortest distance of the three alternatives in the Flathead drainage. The existing road will require additional width and upgrading for greater load-carrying capacities.

The Railroad

The most economical means of transporting the three million tons of annual processed coal to its west coast destination is by rail. Considerable concern has been expressed that the railroad might come south, down the North Fork Valley to Columbia Falls, connecting with the existing Burlington Northern line. While this alternative might be the most economical, it is not being considered by the company and is not desired by the British Columbian government.

Three possible rail routes were identified in the province. The most northern route, known as the McGillivray route, was selected because of economics. This route will follow the Flathead River Valley north, go through the Flathead Pass area, and connect with the main Canadian Pacific line in the McGillivray loop area. The McGillivray route would involve 47 miles of track and a 2.7 mile tunnel in the Flathead Pass area at a cost of approximately $75 million.

Electric Power

Initial plans for mine development included the construction of an onsite thermal-electric generation facility. These plans were cancelled due to economics and potential transboundary air pollution. Electric power needs for the mine and community are estimated at 30 megawatts and will be provided by British Columbia Hydro through a 230-kV transmission line from Natal, British Columbia. The transmission line is planned to follow the same route as the rail spur, thus minimizing environmental impacts as opposed to the construction of a separate corridor for the transmission lines.

THE NEW TOWN

Sage Creek Coal Company Limited is pursuing the development of a support or resource community near the mine site in the North Fork Valley. The company has stated their intention that this new town include all the amenities and facilities expected in any modern community and that it be an independent municipality controlled by its citizens (Hinton, B. R., and Associates Limited et al. 1976a).

In the past, communities which were started in conjunction with a single enterprise in isolated areas were commonly known as "company towns." The parent company provided all facilities, and the residents depended on the

company for housing, utilities, entertainment, and their means of livelihood.

Housing facilities were rarely adequate, schools were below standard, retail trade provided no choice, social climate was usually poor, and the community was not incorporated. All of these factors led to a high rate of labor turnover and an impersonal environment.

In British Columbia prior to World War II, the resource community was generally pictured as a company town. Since that time the nature of resource communities has changed considerably. The reasons for these changes are: long-term operations at one site, a need for stable work force, a basic dissatisfaction with company town life, a demand for skilled technicians who in turn demand a wide variety of modern urban amenities, and an increase in government regulations.

The present trend in British Columbia, among isolated resource developments, is to a planned resource community commonly known as an "instant town." The instant town is initiated by the company at essentially the same time as mine construction. The company builds the necessary facilities to attract and house the initial work force.

In the initial stage of development, retail trade and service facilities are provided to meet the daily needs of the population. This practice eliminates the need to travel to other communities for these goods and services and helps establish a local feeling of community. However, a regional service center is still important in providing broader services, such as major medical care, or larger purchase items, such as appliances.

Once the mine and a permanent population is established, the community will incorporate. Incorporation is to the benefit of the residents and the company as well. Residents gain a degree of control over their local destiny through a local government and town council. The companies favor incorporation because it frees them of many administrative tasks. Once the community is incorporated, the general trend in British Columbia has been for the companies to turn over mine-built facilities to the local government, usually for a nominal fee of $1.00.

The incorporation of the resource community usually will include the mine site in the incorporated boundaries. This creates a larger tax base for the community and makes the company the major taxpayer. The company benefits by being relieved of the responsibility to create a more amenable community. While the "instant town" is a step in the right direction from the traditional company town, many problems and drawbacks still exist.

Population of the New Town

At the beginning of the project, the town population is expected to be 1,700. Five years after the beginning of mining, the mine and associated facilities should employ 875 workers. Using the assumptions shown in table 7, the town population is predicted to be 2,800 people.

TABLE 7

ASSUMPTIONS USED IN PREDICTING NEW TOWN POPULATION

Employment	Employee Status				Jobs for Family Members
	Single	Married Childless	Married Children	Average No. of Children/ Family	
Basic Industry	30%	15%	55%	2.25	2% wives employed
Derivative Services (14% of basic employment)	20%	20%	60%	2.10	1.38 persons/ family

SOURCE: Hinton, B.R. and Associates Limited et al. 1976b, p. 14.

Alternative Sites for the New Town

Five sites in the North Fork Valley (figure 7) have been identified as having the potential for development for the community intended, based on these criteria (Hinton, B.R., and Associates Limited et al. 1976a, p. III-13):

"Travel Distance - no more than 32 km (20 miles) from mine site and no closer than 5 km (3 miles) to give adequate clearance from industrial operations.

Adequate Land Area for Development and Reserves - a land requirement of approximately 85 developable hectares (210 acres) for the settled stage requirements of an 875 basic industry work force with 60 hectares (150 acres) of developable reserve is indicated by preliminary projections.

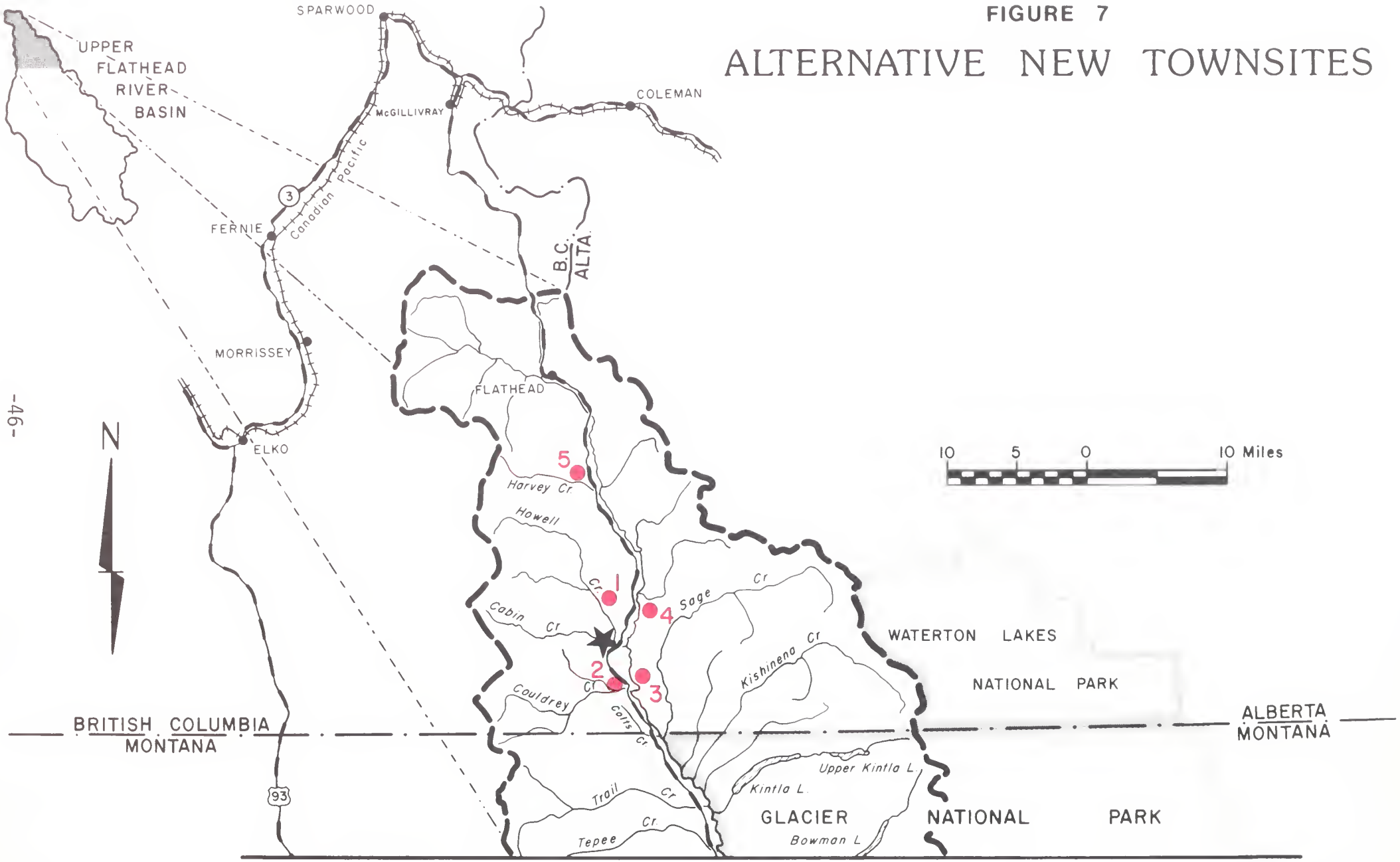
Soil and Drainage - clear of floodplain with first preference to good-draining gravel terraces and second preference to glacial moraine terraces with slopes in the 0 to 12 percent range.

Sun Orientation - sloping toward the south within an east-south-east to west-south-west arc, and free of significant cutoff from nearby peaks and ridges.

General Climate - shielded from major prevailing winds; minimal snow drifting; clear of cold air which is funnelled down creek and river channels; and shielded from other detrimental features of microclimate. It was imperative that the townsite location be clear of exposure to storm winds between October and May and of the microclimatic cold air drainage flows toward the valley floor. Conversely, the capture of summer breezes in July and August would provide relief from extreme heat.

FIGURE 7

ALTERNATIVE NEW TOWNSITES



Water Supply and Sewage Disposal - within reasonable distance of an all-year creek supply or creek-based aquifers for water supply and within reasonable distance of creek or river with sufficient flow to receive sewage treatment effluents.

Freedom from Major Environmental Dangers - avalanche paths, rock slide paths, 100-year floods, forest fire paths, etc."

Although the final decision has not been made, the company indicated in their Stage I report that Site 2 at the confluence of Burnham and Couldrey creeks west of the North Fork (halfway between the mine and the U.S.-Canadian border) was the most desirable. Since then, the company has identified the site near the confluence of Harvey Creek and the North Fork (approximately 12 miles north of the mine) as being highly preferable.

PART III

ALTERNATIVE LEVELS OF FUTURE DEVELOPMENT

In order to assess specific impacts that may result from future development of Cabin Creek coal reserves, it was necessary to assume a specific level of future development. Even though Sage Creek Coal Company Limited has submitted a mining proposal, it is apparently too early to assume confidently that any particular level of development will occur. Therefore, in order to establish a range of future impacts within which the actual level of impact will probably occur, three specific future levels of development were considered in this study and are described below. These three are not the only development levels which could possibly take place in the Upper Flathead River Basin; however, it is probable that the actual level of development will resemble one of these alternatives closely enough to make these impact assessments useful.

ALTERNATIVE 1: DEVELOPMENT OF CABIN CREEK COAL WITH A NEW TOWN

This alternative assumes that development of Cabin Creek coal, including mining and construction of a support community, would proceed exactly as proposed by Sage Creek Coal Company Limited in the Stage I report submitted to the British Columbian Government. That proposal is summarized in Part II of this report, pages 33-47.

It is possible that mining may proceed on a smaller scale than that indicated in the proposal. Additional information from Sage Creek Coal Company Limited indicates a reduced level of development may be considered. This would involve:

1) mining only 1.5 million tons per year instead of 3 million,
2) transporting the coal by haul traucks to an existing rail line rather than building the $75 million rail line proposed in the Stage I report, and
3) mining only four coal seams rather than the five originally planned, a decision which would make it unnecessary to mine below the valley floor.

Even though the project finally undertaken may be considerably smaller than the one proposed, no smaller case is considered as an alternative in this report.

The number of ways in which the proposed level of development could be altered is infinite, as is the number of ways and the extent to which that development could affect the natural and cultural environment. Consideration of some reduced development level is not possible in this report since there is no indication from the company as to what that reduced level might be. Therefore, only the proposed development (with one variation, as explained in the next alternative) is considered in this report; any reduced level would presumably result in less impact.

ALTERNATIVE 2: DEVELOPMENT OF CABIN CREEK COAL WITH NO NEW TOWN

This alternative assumes that the project would occur as proposed except that no new town would be built. With no new town at or near the mine site,

workers would have to find housing in existing communities or in individual homesites.

There are three existing communities in Canada (figure 8), Sparwood (4,000 people), Fernie (4,500), and Elko (250) in the Elk River Valley, which offer services and are capable of expansion. The greatest potential for expansion is in Fernie, presently experiencing some emigration to Sparwood. Local officials of Fernie felt housing of the workers in Fernie would be more advantageous than development of a new town. Fernie already possesses many of the service facilities, such as schools, a hospital, and retail and service outlets, necessary for a work force of this size. However, Fernie is located over 56 miles from the mine site, creating a significant commuting distance for mine employees. Union officials have discouraged Fernie as the mine's housing center because a daily one-hour, one-way trip by road or rail would be excessive.

Scattered development will probably occur if workers purchase homesites away from existing communities. Limited private land is available in British Columbia. However, private land in the Montana portion of the drainage would be more attractive since subdivided lots already exist, and the commuting distance would be only 11 miles from the mine site to the border.

The U.S. Immigration and Naturalization Service requires an immigrant visa in order for an alien to establish residency. Presently, applying for a visa requires a payment and a waiting period. It is possible to obtain a waiver of the waiting period if the resident alien would not be displacing any United States labor in the United States labor market. As the work location is in Canada, this labor certification would probably not apply, and a waiver could be obtained. Accordingly, this situation has to be considered as a possibility in evaluation of impacts. It is assumed, for the purposes of this report, that 50 percent of the workers would live in Canada and 50 percent in the U.S., in the North Fork Valley near the border. This percentage split is arbitrary since the actual percentage of workers choosing to live in Canada or the U.S. could vary.

ALTERNATIVE 3: NO DEVELOPMENT OF CABIN CREEK COAL

This alternative assumes that no industrial development will take place along Cabin Creek in Canada. Instead, economic and social growth will take place according to current trends in the basin.

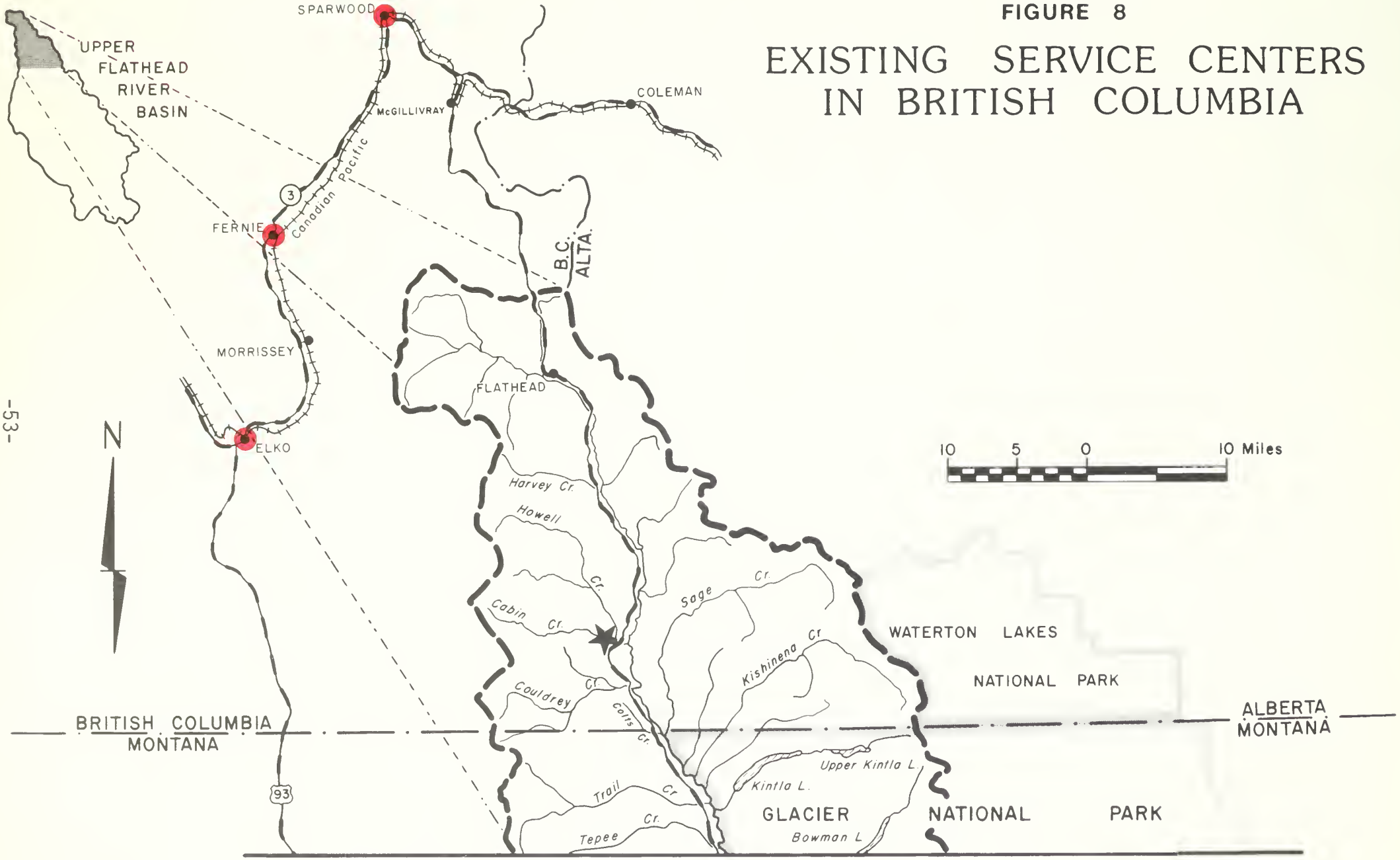
Population

Table 8 shows population growth in Flathead County, which contains almost all of the study area, projected to 1990. Most growth is projected to occur in the unincorporated areas of the county, and in the Kalispell and Whitefish jurisdictional areas, assuming that these areas do not request annexation.

Year-round residency in the North Fork Valley is expected to increase from its present estimated level of 30 persons, but quantified projections are not available. Summer residency should also increase. In the past, poor access, harsh climatic conditions, and more recently the lack of such utilities as electricity and telephone service have limited development.

FIGURE 8

EXISTING SERVICE CENTERS IN BRITISH COLUMBIA



As demand increases for oil and gas, timber, second-home development, and recreational opportunities, pressures will increase for improved access to the North Fork Valley and for provision of basic utilities. Population growth will follow.

TABLE 8

PROJECTED POPULATION GROWTH IN FLATHEAD COUNTY

Area	1970	1977	1980	1985	1990
City of Kalispell	10,526	11,129	11,690	12,649	13,599
Kalispell Jurisdictional Area	NA	20,898	22,518	25,218	27,918
City of Whitefish	3,349	3,618	3,855	4,250	4,645
Whitefish Jurisdictional Area	NA	7,249	8,185	9,745	11,305
City of Columbia Falls	2,652	3,288	3,600	4,120	4,639
Columbia Falls Jurisdictional Area	NA	5,646	6,132	6,942	7,752
Flathead County Jurisdictional Area	NA	16,148	18,560	22,580	26,600
TOTAL COUNTY POPULATION	39,460	49,941	55,395	64,485	73,575

SOURCE: Flathead County Areawide Planning Organization, 1976, pp. 2 and 5.

NA - Not Available

Economy

Economic projections are not available specifically for the North Fork Valley, but general statements can be made about the economic future of Kalispell and of Flathead County. Kalispell will continue as a regional retail trade center; and tourist trade, a large portion of Kalispell's retail trade, will increase. As Kalispell's population increases, so will its services sector, enabling the city to continue as a regional services center.

The county economy should also see a continuation of current trends. The finance, insurance, and real estate sector should maintain a steady three percent of total earning and employment. The transportation, communication, and public utilities sector of the county economy will continue to decline

in importance in both total earnings and total employment, as will farming, mining, and contract construction.

Oil and Gas Exploration and Development

Oil and gas leasing applications for exploration and development were applied for: 1) in the fall of 1974 on about 118,000 acres of National Forest Lands, and 2) in April 1975, on 7,760 acres cf State Forest Land in the North Fork drainage. Because of these applications, oil and gas development is considered as a possible continuation of an existing situation. However, because it is not at all clear how much, if any, development will occur, and because it was not the purpose of this study to investigate possible oil and gas leasing, impacts resulting from such development will not be identified in Part IV.

Prior to the letting of oil and/or gas leases, an environmental impact statement is required assessing the impacts to the area influenced by the development and identifying the type of development. In 1976, the U.S. Forest Service submitted a report on oil and gas lease applications; and the Montana Department of State Lands and Department of Natural Resources and Conservation wrote a Final Environmental Impact Statement on Proposed Oil and Gas Leases, Coal Creek State Forest. The processing of the applications for oil and gas leasing was discontinued when funding to the Secretary of the Interior for the processing was cut off until October 1977.

PART IV

ENVIRONMENTAL IMPACTS

The potential impacts from the project proposed by Sage Creek Coal Company Limited are described in detail below. The specific development program is in a state of fluctuation at this time and therefore necessitates the examination of alternative levels of development in order to assess potential impacts. The proposed project and alternative levels of development are discussed in detail in Parts II and III, respectively. For summary purposes, the alternative levels are as follows:

1. The section on impacts of the "development with new town alternative" analyzes the effects upon the various environments if the proposed project takes place as currently planned by the development proponent.

2. The section on impacts of the "development with no new town alternative" analyzes the effects upon the various environments if the proposed project takes place at the level of production, operations, and schedule currently planned, with the exception that a new community at or near the mine site would not be constructed and the assumption that the work force would be equally dispersed between residential locations in Canada and the United States.

3. The section on impacts of the "no development alternative" assesses the effects upon the various environments if the proposed project does not take place.

The impacts of the above alternatives are described in detail below.

THE DEVELOPMENT WITH NEW TOWN ALTERNATIVE

Under this alternative, the potential impacts on the physical and natural environment are significant, yet the possibility of occurrence will be minor under the assumption that British Columbia regulations and guidelines are enforced. The impacts on the socio-economic environment would be minimal. A full description of the proposed development is contained in Part II of this report. Under this alternative, maximum impact will occur in Canada, with only limited impacts potentially possible for the United States portion of the North Fork.

Physical and Natural Environment

Impacts could occur in the areas of water quality, channel morphology, and fish and wildlife habitat.

Water Quality

Development of the project as proposed has the potential of degrading the water quality of the Upper Flathead River Basin. These potential impacts would be attributable to various construction and operational methods and procedures which are outlined in the following discussion.

The water and air erosion of materials from disposal and excavation areas, road and railroad construction, and community development all have

the potential for contributing to water quality degradation by increasing the amounts of total suspended solids (TSS) and total dissolved solids (TDS) entering into the Flathead stream-river-lake system. With the increase in TSS and TDS, there would be a corresponding increase in organic color and turbidity. The intensity of impacts from this increased material will depend specifically on the chemical properties of the materials and the time of year they are washed into the Flathead River system.

An increase in TSS and TDS during spring runoff would have a minor impact on water quality because of the high levels which already exist during this period. However, increased concentrations during periods of low flow could have a severe impact dependent on the quantity and quality of materials.

The overburden materials present in the South and North Hills are comprised primarily of sandstone with interspersed shale deposits. A bentonitic clay seam has been identified in the South Hill. If the clay is allowed to enter into the aquatic ecosystem, it could influence riverine strata and reduce phosphorus levels in Flathead Lake. The level and presence of toxic metals and materials in the overburden wastes is not known at this time, therefore making it impossible to define potential impacts.

The presence of waste coal from the mining and preparation plant may also contribute to water quality degradation. If coal is allowed to enter the aquatic ecosystem, total organic carbon levels would be increased. Although the sulfate concentrations in the Cabin Creek coal are low, a slight increase could cause a corresponding increase in the acidity of the water in the North Fork, causing toxic metals to go into solution more easily. The level of toxic metals may not exceed established water quality standards, but these metals have been found to concentrate in fish, making consumption by other animals and man harmful.

A primary concern is the design of the settling ponds and the length of retention time necessary for settling out suspended materials. A failure of these ponds could cause leakage of waste materials into the North Fork. Design specifications of the ponds and their corresponding drainage canals and ditches have not been detailed, and storm runoff holding capacities are not known. Due to high storm runoff potentials, ranging from 59 cfs to 200 cfs, the holding facilities will have to have excess capacities if failures are to be avoided.

Artesian aquifers in the North and South Hills may contribute a total discharge of 2.5 cfs to the settling ponds. This water may have high levels of phosphorus. If such waters are discharged into the North Fork, it is possible that the rate of eutrophication of the Flathead aquatic ecosystem would be increased. Phosphorus has already been identified as the limiting factor in this system.

Water pollution from the new town's sewage disposal system could be present in the North Fork. Increased nutrients, TDS, temperature, fecal coliform organisms, and a lowering of dissolved oxygen may occur if proper regulatory measures are not taken.

The location of a new town with an attendant population of approximately

3,000 people will cause degradation of air quality in the transboundary airshed. Air pollution from automobile emissions, heating facilities, etc. will be generated in a valley which is presently sparsely populated.

Channel Morphology

Channel morphology of the North Fork could be affected by the proposed diversion of Howell Creek from its existing watercourse to a new location east of its present course. This change in channel could create a steeper slope and reduce the length of available streambed, with attendant possibilities for increased siltation and runoff.

Fish and Wildlife Habitat

Water pollution could cause fish habitat damages by reducing the quality of the habitat and spawning areas for cutthroat trout and Dolly Varden migrating upstream from Flathead Lake. The change in the watercourse of Howell Creek could reduce the amount of available habitat. Siltation and/or erosion of bentonitic clay materials from the South Hill into the watercourse could also affect habitat by filling up the interstitial spaces in the stream bed, causing loss of benthic insect and fish egg habitat.

Socio-Economic Environment

Most of the direct impacts in this area will occur in Canada due to location of the new town at or near the mine site.

The proximity of a concentrated population center in Canada (figure 7, page 46) will also cause pressures to upgrade the North Fork road to all-weather, hard surface road to be open year-round, enabling community residents to travel to Columbia Falls and Kalispell for shopping and services.

The population concentration would also intensify pressures on the recreation resource (hunting, fishing, camping, boating, etc.) in the North Fork area.

A major impact, primarily beneficial, would accrue to the Kalispell area due to its role as the regional retail trade and service center. A majority of the new town residents would probably prefer to patronize establishments in Kalispell due to the choices and level of services available and because the new town would not be of sufficient size to offer these choices. It is anticipated that a majority of the new town residents would travel to the Kalispell area for retail goods and services and other services such as major medical, dental, and banking.

Legal and Institutional Framework

With minimal impacts on the socio-economic environment and with only limited potential impacts on the physical and natural environment, it is probable that the Boundary Waters Treaty of 1909 and International Joint Commission (IJC) provisions are adequate to resolve any required mitigation

of impacts or resolution of problems. This Treaty provides for the resolution of transboundary water-related conflicts.

THE DEVELOPMENT WITH NO NEW TOWN ALTERNATIVE

This alternative presents the situation that would have the greatest impact potential for the United States portion of the North Fork, under the assumption that British Columbia mining regulations and guidelines are enforced. The impact potential from mine employees living in the United States would be the greatest in the socio-economic area with some impacts on the physical and natural environment from increases in sewage and solid waste disposal, automobile emissions, and loss of wildlife habitat.

The Development With No New Town Alternative has the same level of mining and coal processing operations as proposed under the Development with New Town Alternative, but it has the work force and attendant population equally dispersed between residential locations in Canada and the United States. The Canadian population would probably be dispersed in existing Canadian communities. Because of the proximity of the mine site in Canada to the border, the driving time and distance (11 miles), and the condition of the North Fork road, it is probable that any Canadian population relocation in the United States would occur in the area north of Polebridge to the border. The major determining factors as to whether a significant population influx would occur are as follows: (1) the new town approach is the preferred alternative by the Canadian government, labor unions, and the project development proponent; (2) certain institutional constraints and barriers may restrict the residential location of Canadian citizens in the United States; and (3) the North Fork area in the United States north of Polebridge is an undeveloped area with virtually no community facilities or services available.

In view of these constraints, The Development With No New Town Alternative may not occur. Discussion of the potential socio-economic impacts is included as a contingency situation so that should it occur, assessment of the impacts will have been evaluated. Due to the lack of mitigating measures or controls available to the United States (Flathead County and the State of Montana) to cope with the potential socio-economic impacts, The Development With No New Town Alternative should not be advocated. Potential impacts under this alternative are discussed in more detail in the following sections.

Physical and Natural Environment

The same types and levels of potential impacts from mining development would occur as described under The Development With New Town Alternative. Also, additional physical and natural environment impacts would result from a dispersed population in the U.S. portion of the North Fork. Adequate amounts of privately owned land are already available in the North Fork area and have been subdivided for residential purposes (3,940 acres); development of these undeveloped lands for residential and other uses could result in increased pressures to "open up" the North Fork area to other development activity.

Increased population pressures would require the upgrading of North Fork Road to an all-weather, surfaced road to provide access to the mine

site in Canada. The increased access and a resident population would intensify pressures on the recreation resources (hunting, fishing, camping, boating, etc.).

Water Quality

The construction of housing to accommodate the increased population could cause water quality degradation. Assuming the development of housing on an individual basis, each unit will require a well and septic tank. This type of development could cause the lowering of ground-water tables, causing sewage infiltration from cesspools and septic tanks into streams and wells.

Channel Morphology

No direct impacts to channel morphology are anticipated beyond those discussed above under the Development With New Town Alternative.

Fish and Wildlife Habitat

An increase in resident population in the North Fork would reduce the available wildlife habitat areas. The existing subdivided lands in the North Fork Valley are prime winter range habitat for ungulates and may be critical habitat area for grizzly bear (Federal Register 41(215):28757-59; November 5, 1976). Fish habitat may be damaged on a small scale.

Socio-Economic Environment

A number of possibilities, primarily constraining, could alter the magnitude of potential socio-economic impacts occurring in the United States.

Without an immigrant visa, Canadian residents would be prohibited from establishing residency in the United States and would be forced to reside in Canada, either in existing communities or in dispersed locations. The result of such an action would virtually eliminate socio-economic environmental impacts to the United States.

Under this alternative, the United States would receive beneficial impacts since Canadian residents would probably continue to shop for regional goods and service needs in the Kalispell area. Expenditure levels could even be higher than under the new town case due to a lack of comparable Canadian facilities under a dispersed settlement pattern. Daily goods and service needs would have to be obtained in Columbia Falls and Kalispell in addition to meeting regional needs.

The waiver of certain of the visa requirements or of compliance with specific immigration regulations could alter the situation, causing impacts to occur. This latter situation, described below, would offer potentially major impacts on the socio-economic environment of the United States portion of the North Fork.

For evaluation purposes, an equal distribution of the project's work force and population was made, 50 percent to both Canada and the United States. Based on the projections made by the project development proponent, the total population influx to the United States could be 1,400 people (table 9).

TABLE 9

ESTIMATED POPULATION INFLUX INTO THE U.S. PORTION OF THE NORTH FORK
(if no new town is built)

Total Population			1,400[a]
single		350	
married childless		210	
married with children		840	
adults	420		
children	420		

[a]Refer to table 7, page 45, for the allocation formula.

With a current (1976) estimated population in the North Fork area of 30 year-round residents and 200 summer seasonal residents, 1,400 people would be a major influx of population into this sparsely inhabited and under serviced area. The new population would be year-round, permanent residents; the level of 1,400 people would be reached approximately five years after mining begins. No community facilities or services exist north of Columbia Falls except for a combination general store, post office, and gas station at Polebridge. There are no schools, retail-commercial stores, churches, etc. in the area. Police and fire protection services are marginally available, being serviced out of Columbia Falls. Utilities are available to the area but are not in place at the present time. No centralized sewerage or water supply services are available at the present time.

Accommodating this projected population would necessitate the construction of virtually every facility and service in the area to provide for a minimum level of amenities. Schools would have to be constructed, fire protection services would be required, and other service areas would also necessitate construction programs. With the property tax system as the major means available for providing these services and facilities, it is unlikely that they could be paid for within the present taxation structure. The federal income tax structure would not provide revenue funds from Canadian citizens working in Canada and living in the U.S. since no payment or filing of U.S. income taxes is required. (Chuck Egburt, U.S. Internal Revenue Service to Hanley Jenkins, Montana DNRC: personal communication, November 19 and 23, 1976, Helena). The State of Montana tax structure would require the residents to file tax returns; however, a credit on all income taxes paid to Canada would be given (Chuck Stein, Montana Department of Revenue to Hanley Jenkins, Montana DNRC: personal communication, November 19, 1976, Helena).

A large number of resident aliens residing in the United States and increased access if the North Fork Road is upgraded, would probably necessitate increased manning of both the Canadian and United States customs/port of entry stations.

The impacts described above are major and significant in affects on the socio-economic environment. It is unlikely that the population influx could be absorbed or accommodated in the North Fork area without causing major problems, particularly on the community development infrastructure base, in providing an acceptable standard of facilities, services, and amenities. The existing mitigating measures available to the United States (primarily Flathead County and the State of Montana) are inadequate to effectively resolve the multitude of problems that could be created.

Legal and Institutional Framework

The Treaty and IJC provisions are available to assist in problem resolution. However, the conflicts potentially possible due to the developments discussed here were not envisioned in the intent or language of the Treaty. Invocation of the "injury" provisions of Article II and "injury to the property" provisions of Article IV by the United States would be necessary to commence the negotiation provisions of the Treaty in order for the Commission to develop remedial solutions.

THE NO DEVELOPMENT ALTERNATIVE

In the event that the development does not proceed as planned, and assuming that no other development projects of a similar nature or magnitude occur, the impacts would be essentially those of the current or baseline situation described in Part I of this report.

The following categories of impacts would occur without the Cabin Creek development project.

Physical and Natural Environment

It is likely that all aspects of the environment will continue in their relatively pristine nature without the proposed development.

Baseline water quality information on the North Fork system indicates that surface water is pure enough to be consumed as drinking water. Present trends indicate no reason to expect a change from this high quality aquatic ecosystem.

The present trend of second home development in the North Fork is not enough to influence the physical and natural environment with any major impacts. Reduction of wildlife habitat may occur due to loss of ungulate range. Sediment loading from road and housing development would continue.

Socio-Economic Environment

The impacts upon land use, transportation systems (North Fork road), and recreational use would remain essentially unchanged from current trends in the North Fork area. The exception to this, although not attributable to the proposed project, is the Wild and Scenic River designation on the North Fork (appendix D). Dependent upon the final management plan developed for the North Fork, it is possible that increased recreation use of the river resource could increase the demands and pressures for development of facilities and services in the North Fork area. This could also intensify the pressure for additional land use developments close to the North Fork to take advantage of the opportunities that the Wild and Scenic River designation may generate. The Wild and Scenic River designation situation is the same for all three alternative cases discussed.

Under the No Development Alternative the role of Kalispell as the regional goods and services center would remain the same; the trend will continue but at a decreased level over what would likely take place with the project.

Legal and Institutional Framework

The planning efforts currently underway in the Flathead Drainage 208 Project, together with increasing levels of enforcement regulation in the water quality and discharge permit system under the Water Quality Bureau of the Department of Health and Environmental Sciences, and the more stringent enforcement of subdivision regulations with respect to ground-water tables, domestic wells, and septic tanks will result in improved water quality management.

Without the proposed mining project there is little likelihood of a situation arising which would require invocation of the 1909 Boundary Waters Treaty and its implementation procedures (IJC). Any use of the Treaty provisions would be attributable to other non-project events or actions. These would be considered outside of the "no-action case" and would be administered separately under the Treaty procedures and requirements.

PART V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY AND CONCLUSIONS

The major objectives of HB 622 (Montana Session Laws 1975) were to develop an environmental baseline for the described study area and to prepare evaluations of the probable environmental and socio-economic impacts from development of the Cabin Creek coal deposits. The major requirements under the law are outlined in figure 9.

The Existing Environment of the Upper Flathead River Basin

The quality of the Upper Flathead River Basin waters is good to excellent except for such streams as Ashley Creek and Stillwater and Whitefish rivers during low flows. The aquatic ecosystem supports a reproductive population of native westslope cutthroat trout and Dolly Varden. Benthic insect species are numerous and uniformly distributed where sampled except where man-caused influences persist, e.g., below Hungry Horse Reservoir.

A wide variety of vegetative types is found in the Basin. The Flathead River Valley south of Columbia Falls has been extensively cultivated for agricultural grain and grassland crops. Pine forests dominate the surrounding mountains and tributary valleys with interspersed native grasslands. Terrestrial habitats in the Basin support nearly all species of animals found in northwestern Montana west of the Continental Divide. Certain species of wildlife have been identified as endangered, threatened, or rare such as the peregrine falcon, grizzly bear, and fisher.

The high quality environmental experience available has helped bring about a doubling of Flathead County's population since 1940, making it the sixth largest county in terms of personal income and earnings in Montana. Kalispell has become the regional shopping center for the county, offering the greatest variety in services and retail trade.

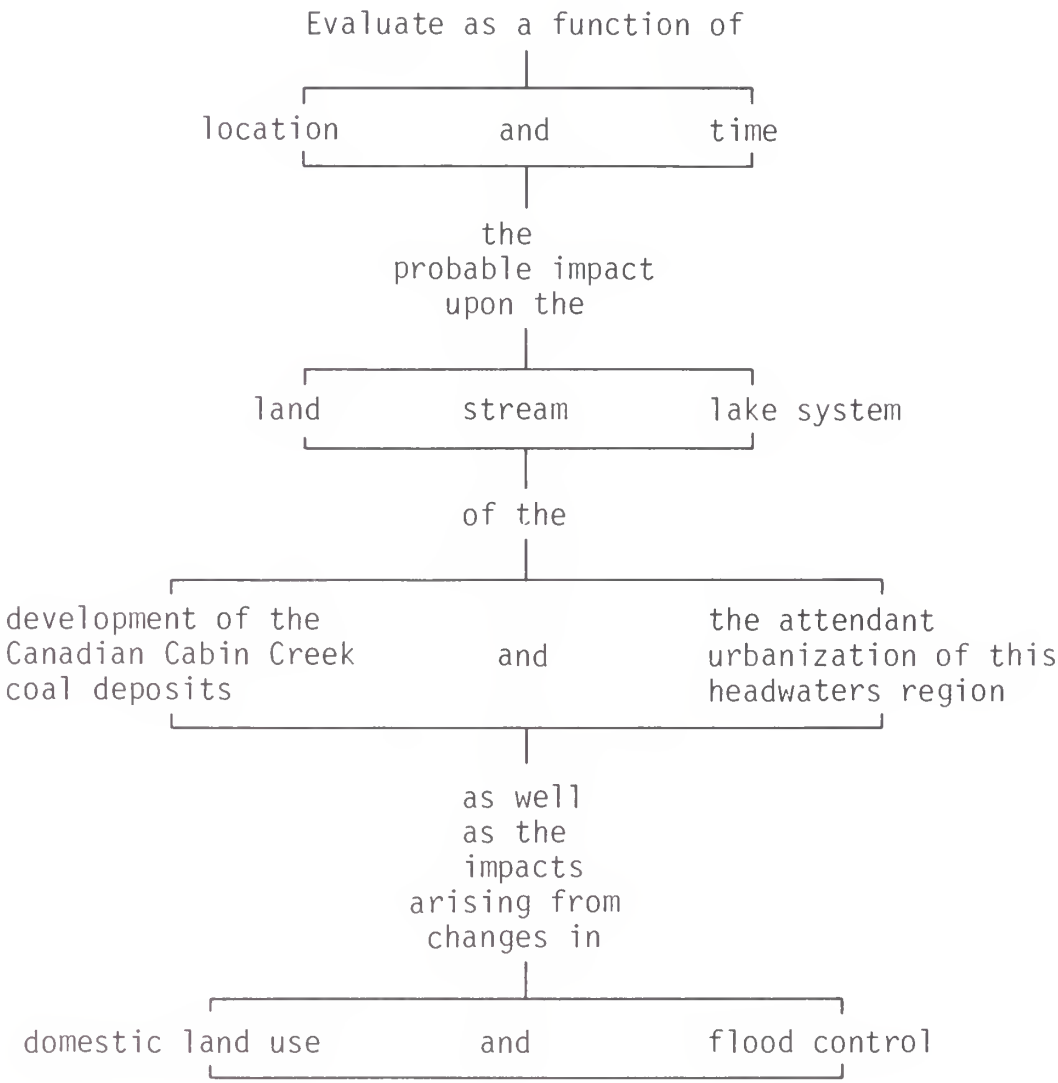
Irrigation is the largest water use practice adjacent to the North Fork and mainstem Flathead River, depleting surface and ground-water sources. While instream water uses are difficult to quantify, they are especially important in the Basin because of demands for recreation and fish and wildlife conservation.

The Proposed Project

The proposed Sage Creek Coal Project defined the mining of three million tons per year of a medium volatile bituminous coal from two hills, north and south of Cabin Creek in the southeastern corner of British Columbia. The mining practice to be used is "open pit mining" requiring the removal of the eastern faces of the North and South Hills. The coal will be processed at a coal preparation plant on the site and shipped by rail to Roberts Bank on the west coast of British Columbia. Other support facilities are scheduled such as an all-weather road from the mine to the Elk River Valley, electric power transmission lines from Natal, British Columbia to the mine site, and a new resource community to house and provide services to mine employees.

FIGURE 9

FLOW DIAGRAM OF IMPACT ASSESSMENT REQUIRED UNDER HB622



Alternative Levels of Future Development

Three alternatives of future development were assessed, because the final level of development has not been chosen by Sage Creek Coal Company Limited. Alternative 1 assesses the development of Cabin Creek coal with a new town and assumes development would proceed as proposed in the proponent's Stage I report. Alternative 2 evaluates development of Cabin Creek coal with no new town. The mining and processing of the coal would occur as in Alternative 1 except the employees would live in existing communities in British Columbia or on individual homesites either in Canada or the United States. Alternative 3 assumes no development of Cabin Creek coal deposits will occur and assesses the present trends in the North Fork.

Environmental and socio-economic impacts to Montana were assessed for each alternative.

Environmental Impacts

The evaluation of impacts to Montana from the development of coal deposits in the Cabin Creek area has been grouped into three categories:

> physical and natural environment - discusses those impacts that relate to the mine development, mining operations, coal processing facilities, transportation systems, reclamation operations, and community development.
>
> socio-economic environment - includes those impacts on the socio-economic environment that could be caused by the proposed project and associated community development. Primary emphasis is placed on the transboundary, regional, and economic base aspects.
>
> legal and institutional framework - concerns those provisions of law and regulations, primarily Canadian federal and provincial, that serve as the framework within which the project and the potential impacts must be viewed. Other major considerations are the Boundary Waters Treaty of January 11, 1909, and the implementation procedures and requirements specified by the International Joint Commission (IJC).

Physical and Natural Environment

The proposed project under any development level would have a low probability of significant impacts upon the physical and natural environment under the assumption that Canadian rules and regulations are strictly enforced. The exceptions involve water quality, channel morphology, and fish and wildlife habitat.

Water Quality. It is possible that the mining and coal processing operations could pollute and thus degrade the water quality of the North Fork Flathead

River, both in Canada and the United States. Seepage from settling ponds, drainage ditches, and canals is likely. Erosion of soil, waste and spoil materials, and toxic minerals during the construction, operations, and reclamation phases of the project is also a possibility. Fugitive dust may cause air quality degradation and then settle into the water causing water quality degradation. Failure of the settling ponds and/or drainage ditches and canals could also contribute to a reduction of water quality.

If a new town is developed near the mine site, water pollution could result from the sewage disposal system. If no new town were built and workers built homes in the U.S., some pollution might result from the increase in individual septic systems.

Channel Morphology. A number of alternative routes for the relocation of Howell Creek have been considered. One route would divert Howell Creek northward from its present location into Beryl and Marl Lakes. The alternative to this diversion would be to rechannel Howell Creek south of its present location and into the North Fork. Either alternative could cause impacts. The north route could involve the washing of organic materials from the lakes into the North Fork in the event of flood or overflow situations. The south route would involve construction of a new channel. Reduction of the channel length and creation of a steeper, man-made channel would cause changes in channel morphology, with attendant effects on downstream portions of the North Fork in both Canada and the United States.

Fish and Wildlife Habitat. Pollution and/or changes in channel morphology of the North Fork and tributary streams in Canada could cause damage to the spawning beds of the migratory fish, e.g., westslope cutthroat trout and Dolly Varden populations, both for Canada and the United States. Loss of crucial upstream fish and insect habitat would have a direct bearing on the downstream fisheries resource.

Wildlife habitat would be lost if no new town were built and part of the work force chose to reside in the U.S.

Socio-Economic Environment

Depending upon the final location of the worker's residences, impacts could be significant for the area in which they reside. If a community or residential area is developed at or near the mining and processing site in Canada, the impact upon the North Fork area in the United States would be minor. Should the community or residential area not be built in Canada, then the impact potential could be major for the North Fork area in the United States. If a significant number of the project's work force reside in the United States, there could be significant impacts upon the North Fork areas's community infrastructure and facilities-services base.

If the work force resides in Canada either at a project new town, in existing communities or dispersed in homesites in the Canadian North Fork area, virtually no negative socio-economic impacts would accrue to the United States. Impacts on the United States would probably be of a beneficial nature, in that the project's population would provide additional income

sources for United States businesses and service groups. This population would make expenditures for goods and services in the regional center of Kalispell as well as other Flathead County communities. The adverse impacts from a sizeable population in close proximity to the border would include intensification of demands for improving the North Fork road to a hard surface, all-weather standard to facilitate access to the Kalispell area. This improvement, in turn could generate pressure to further open up the relatively undeveloped land resources of the North Fork area in the United States.

A situation could arise where the work force and related population could reside partially in Canada, with others resident in the United States. The presence or absence of legal and institutional constraints is discussed on pages 63-65. The area north of Polebridge, Montana to the border would be closer to the proposed project than any Canadian community location.

Adequate amounts of available land exist in this area for residential and other uses. Thus, the potential exists for a sizeable population to be located in the North Fork area. The ultimate total number would be dependent upon the number of project employees, together with their dependents, who elect to establish residence there. Impacts from this type of population influx would be significant. There is no avenue available to control residential growth of already extensively subdivided land. Community services such as utilities, schools, fire protection, and others are presently not available.

Other than real property taxes, these new residents would not be subject to either United States or Montana income taxes since their source of income is in Canada. Accordingly, Flathead County would bear the increased costs for providing services while having no mitigating measures available to provide the needed revenues.

The probability of the No New Town Alternative may be low since the development proponent, the Canadian labor unions, and the British Columbia provincial government all advocate that the work force should be totally resident in Canada, preferably at or near the project in the new town development.

Legal and Institutional Framework

The legal and institutional framework has three areas: Canadian federal and provincial law, United States and Montana law, and the provisions of the Boundary Waters Treaty and the International Joint Commission (IJC).

Since the project is in Canada, it is subject to administration, regulation, and control by applicable Canadian federal and provincial (British Columbia) laws, rules, and regulations. United States and Montana laws and regulations do not directly apply, unless they may involve provisions and procedures contained in the Boundary Waters Treaty or written by the IJC established to administer the treaty. The exception to this pertains to visa requirements for Canadian citizens who may wish to reside in Montana while working at the project site in Canada. As discussed on page 63, there appear to be no major U.S. constraints to prevent the work force from residing in the U.S., if no new town is built. If there is a population influx

into the U.S. North Fork area, there appear to be no legal remedies to mitigate adverse socio-economic impacts.

However, there are several methods of recourse if impacts to the natural environment occur. The existing Canadian legislation appears to be adequate particularly in the area of physical and natural environmental impacts, including water pollution. In all circumstances, the administration and management of the regulatory provisions will be the key to effective impact reduction, mitigation or elimination.

Under the assumption that the Canadian federal and provincial laws, regulations, and permit requirements are stringently interpreted, applied, and enforced by the appropriate Canadian officials, the resultant impacts from the proposed project could be minor. Enforcement, regulation, and control by the appropriate Canadian federal and provincial entities in any lesser degree than strict adherence and compliance could result in increasing degrees and incidence of impacts, with attendant effects upon the physical and socio-economic resource base of the North Fork area in the United States.

The provisions of the Boundary Waters Treaty, and the procedural guidelines of the IJC appear to offer safeguards and negotiation methods for resolving water-related conflicts and problems. Under normal practice when problems arise of a transboundary nature, normal diplomatic channels are first pursued to resolve the conflicts. Only if these methods fail or are not successful would the parties refer to the IJC. While the potential for conflict exists, no precisely defined problem can be cited. It appears that convening the IJC is unlikely until a problem exists in sufficient magnitude to warrant the pursuit of a reference by the U.S. Department of State.

An additional problem pertains to the degree of latitude applied in interpretation of the Treaty provisions. Under Article IV of the Treaty, provisions are made that ". . . boundary waters and water flowing across the boundary shall not be polluted on either side to the injury of health or property on the other."

Article II, provides ". . . that any interference with or diversion from their natural channel of such waters on either side of the boundary, resulting in any injury on the other side of the boundary, shall give rise to . . . legal remedies" (Underlining added). Article II violations would be heard in Canadian courts, and the settlement opportunities for United States plaintiffs could be constrained by virtue of being in a foreign court. When a party to the Treaty believes he has been aggrieved and in the absence of diplomatic resolution, he may request IJC intervention.

To date, with an ex post approach to problems, a strict interpretation of Article IV cases, and the potential constraints of Article II situations, the Treaty and IJC mechanism have not been extensively utilized.

It appears that to address situations of the type demonstrated by the proposed project, e.g., potential impacts and problems, an expanded interpretation is necessary in order to deal with problems before the fact. To bring potential problems within the purview of the Treaty, a more liberal and all encompassing interpretation of the Treaty provisions

should be made. A broader definition of injury could include the potential impacts outlined in this report. Also, an ex ante approach to problems, e.g., identification of potential problems before they become a real problem, would enable the IJC to perform as a forum for discussion and negotiation. It is felt that this approach would be within the intent of the Treaty and would provide a greater range of mutually beneficial discussions of transboundary impacts and potential problems under the auspices of the IJC without the formal, quasi-judicial atmosphere of the IJC.

RECOMMENDATIONS

The major difficulty in preparing recommendations for a potential project was that the development size, scale of operations, and schedule has not been determined. This lack of specific data prohibits precise forecasts of potential impacts.

Another major problem is the frustration that the people of the area have expressed in dealing with different levels of government, in getting timely and adequate information, in having their concerns considered, and in having the different levels of government act decisively on those concerns.

The following recommendations are prepared to encompass all of the development levels described in this report, and, hopefully, to bring about a better relationship between the different levels of government, with significant local participation.

(1) The State of Montana should prepare a request to be transmitted to the U.S. Department of State which would ask for:

a. consideration and evaluation of potential transboundary impacts which might result from the proposed Cabin Creek project. The request should also reflect the State of Montana's concern that the International Joint Commission review:

i. the potential for impacts before a project begins, and
ii. the matter in the broader context of policy planning and an expanded interpretation of the Treaty provisions.

b. an appropriation request to the U.S. Congress for a contingency fund for state and local governments to use in:

i. gathering information on the proposed project and its potential impacts via the task forces proposed below, and
ii. in preparing for and resolving problems caused by the Cabin Creek Project.

Existing communication channels, both of a formal and informal nature, should be maintained. Expansion of the task force approach, in both technical and policy matters, as outlined below, should be implemented at the earliest possible date.

(2) An interagency Policy Task Force should be established to provide overall guidance, direction, and coordination of impact considerations in the North Fork area. Membership on the task force would include policy level representatives from the federal, state, and local governmental jurisdictions. At the federal level, due to the international ramifications involved in the Treaty provisions, the U.S. Department of State should be the designated entity. To provide for an executive office level overview and for coordination of the state agencies and departments, the State of Montana representation should be vested in the Governor or Lieutenant Governor's office. It is essential that Flathead County, through the Office of County Commissioners or some other locally determined arrangement, be represented on the Policy Task Force.

The Policy Task Force would be responsible for leadership of the activities to be performed by the technical task force described below. The Policy Task Force would also serve as the primary mechanism for providing liaison, input, participation, and public information activities from the various special interest groups, citizen advocacy groups, and the general public in the North Fork area, regarding the proposed project.

(3) The existing federal Technical Interagency Task Force was established by the U.S. State Department in the fall of 1975. This task force should be expanded to include participation by the state and local agencies having jurisdictional responsibilities and functions in the North Fork drainage. Representation should be limited to technical personnel. The task force should be responsible for assisting in environmental monitoring and evaluation activities in the North Fork area in relationship to the Sage Creek Coal project. Three designated agencies, with lead or primary coordination duties, and representing federal, state, and local levels of government, should direct the task force activities by coordinating all agencies' efforts and assisting in the decision making process of the Policy Task Force.

(4) Flathead County should establish several special study programs in order to develop an adequate data base for impact evaluation purposes. Those studies recommended are:

a. a monitoring system to provide surveillance on residential and related land development activities in the North Fork area, and

b. a special planning program for the North Fork area, within the framework of the existing Flathead County Comprehensive Planning Program. A specific land use and zoning plan should be developed and would contain information on private land availability, development carrying capacities, resource conservation areas, services availability, and zoning adequacy. Policy alternatives should be developed to guide and control the future development of the area.

(5) The existing water quality monitoring program in the North Fork area should be continued by the appropriate federal agencies. Specifically, suspended sediment sampling at the border and all chemical and biological sampling at the Canyon Creek Station should be continued beyond September 1977, the currently scheduled expiration date for federal funding.

(6) An air quality monitoring program should be established by the Air Quality Bureau, Department of Health and Environmental Sciences. This program would enable development of baseline data, preferably at an international border location in the North Fork area, where such data would enable impact evaluations to be made regardless of the ultimate level of resource development that may occur in the North Fork drainage in Canada.

(7) A fish and wildlife habitat assessment and resource inventory program should be established by the Department of Fish and Game. This program would also develop baseline information from which future impact assessments could be made. The program should be coordinated with similar programs currently being conducted by various federal agencies.

APPENDICES

APPENDIX A

HYDROLOGICAL AND LIMNOLOGICAL DATA OF NORTH FORK FLATHEAD RIVER, FLATHEAD RIVER, AND FLATHEAD LAKE

HYDROLOGICAL AND LIMNOLOGICAL DATA FROM PREVIOUS STUDIES OF THE NORTH FORK FLATHEAD RIVER, FLATHEAD RIVER, AND FLATHEAD LAKE

Pertinent government agencies were asked to supply hydrological and limnological data from any aquatic sampling conducted on the North Fork Flathead River, the Flathead River or Flathead Lake prior to September 1, 1975. The data received was compiled and reviewed. Where analysis of the data was required, the respective agencies were asked to provide professional expertise. The summary and analysis of water quality and fisheries information within the upper Flathead River drainage and Flathead Lake was contracted to the Montana Department of Fish and Game.

David Nunnallee, formerly of the Department of Health and Environmental Sciences, Water Quality Bureau, in Kalispell, assisted in the assimilation and analysis of water quality data from various agencies.

Water quality data were divided into five categories: (1) physical parameters, (2) chemical parameters, including nutrients, (3) bio-organic parameters, (4) metals, and (5) pesticides.

Flathead and North Fork Flathead Rivers

Sampling Stations

There are four recognized sampling stations on the North Fork Flathead River and main Flathead River: (1) North Fork Flathead River at the Montana-B.C. border; (2) North Fork Flathead River near Columbia Falls (Canyon Creek Station); (3) Flathead River at Columbia Falls; and (4) Flathead River near Bigfork, Montana. These stations are used by most agencies because, with the exception of Bigfork, they are also the sites for U.S. Geological Survey continuous-recording streamflow gages. In addition, two water-quality stations (North Fork Flathead River at Blankenship Bridge and Flathead River at the old Holt Bridge site) have been monitored for limited water quality data and will be discussed also.

Water quality sampling on the North Fork Flathead River at the Montana-British Columbia border began in October, 1974, with the U.S. Geological Survey's operation of a National Stream Quality Accounting Network (NASQAN) water-quality station. The analysis of the first year's results were not available for this report.

The Canyon Creek gaging station is three miles from the mouth of the North Fork. Water-quality data include one year's monthly sampling by the Montana Department of Health and Environmental Sciences between October 1972 and October 1973 and limited data from the U.S. Forest Service's sampling during the Wild and Scenic Rivers Study (USDA 1973) from 1970 to 1973. A few additional grab-sample analyses were available through the U.S. Environmental Protection Agency's STORET data system (1976).

Water quality data from the station at Columbia Falls for the Flathead River includes one year's monthly sampling by the Montana Department of Health and Environmental Sciences, monthly sampling by the Department of Fish and Game since 1969, some data published by the U.S. Environmental Protection Agency (EPA), and some chemical and pesticides analyses by the U.S. Forest Service.

The EPA data include more than 100 analyses for the more common chemical, physical, and biological parameters, and a single analysis for heavy metals and pesticides.

Water quality data for the station on the Flathead River near Bigfork (at the new Holt Bridge) includes 15 analyses by the Montana Department of Health and Environmental Sciences between 1972 and 1974, ten nutrient analyses for the EPA-sponsored National Eutrophication Survey in 1974 and 1975, and a number of analyses by the U.S. Geological Survey made from 1969 through 1971, ranging from two analyses for certain metals to as much as 25 analyses for some of the more common parameters.

The Department of Fish and Game has operated two water-quality stations at Blankenship Bridge just below the confluence of the North Fork and Middle Fork. This study is primarily interested in the station located on the west bank. Water quality data have been collected monthly since February 1969 at that site.

The Department of Fish and Game has been monitoring water quality parameters monthly at the old Holt Bridge on the Flathead River since July 1963. The distance between the new and old Holt bridges is less than one mile. Because there are no tributaries entering the river between these two stations, they are treated as one.

Physical Parameters

Dissolved oxygen in the Flathead River system remains high all year, averaging 11 milligrams per liter (mg/l) at the Canyon Creek station and 10.5 mg/l near Bigfork, reflecting a low-organic, healthy water quality (table A-1). Highest readings were recorded during winter when the water temperatures were near 32°F.

North Fork pH values are slightly basic with a range of 7.3 to 8.3, a result of the carbonate geologic formations through which the North Fork flows. The water becomes slightly more acidic downstream, with a range of 7.0 to 8.5 at Blankenship Bridge and Columbia Falls and 6.9 and 8.4 at Bigfork.

Temperatures in the North Fork vary from near freezing December through February to nearly 60.8^{o}F in August. High seasonal water temperature in the North Fork is largely a function of flow and would be expected to be higher during low-flow years. Water temperature of the Flathead River at Columbia Falls is directly influenced by daily discharges from Hungry Horse Reservoir. Water releases of 39°F year-round are drawn from the reservoir at 285 and 325 feet below maximum pool elevation. In the winter, water temperatures are warmer at Columbia Falls than in the North Fork. Summer water temperatures may be up to 7°F cooler at Columbia Falls than in the North Fork.

Water temperature near Bigfork has been measured as low as 33°F, significantly warmer than the near-freezing winter water conditions upstream. Bigfork's spring and summer water temperatures, cooled by upstream discharges from Hungry Horse Reservoir, reach a high of about 68°F.

TABLE A-1
WATER QUALITY DATA FROM PREVIOUS STUDIES FOR THE FLATHEAD AND NORTH FORK FLATHEAD RIVERS

	Unit of Measure	Sampling Station		
		Canyon Creek	Columbia Falls	Bigfork
Physical Parameters				
Dissolved Oxygen	mg/l	11.0	10.4	10.5
pH		7.3-8.3[a]	7.0-8.5[a]	6.9-8.4[a]
Water temperature	°F	32.2-60.3[a]	32.2-60.1[a]	32.9-67.1[a]
Specific Conductivity	micro-mhos/cm	205.0	175.0	180.0
Turbidity	JTU[b]	1.0-25.0[a]	0.4-75.0[a]	1.0-130.0[a]
Total Suspended Solids	mg/l	8.0	15.1	28.0
Organic Color	P-C units[c]	---	3.4	4.0
Total Dissolved Solids (Calculated)	mg/l	160.0	140.0	135.0
Chemical Parameters				
Bicarbonate (HCO_3)	mg/l	119.0	103.0	103
Chloride (Cl)	mg/l	0.4	0.5	0.5
Sulfate (SO_4)	mg/l	2.5-13.8[a]	3.2-14.3[a]	2.5-15.3[a]
Alkalinity	mg/l	100.0	86.0	88.0
Total hardness-	mg/l	100.0	87.0	91.0
Calcium	mg/l	30.0	25.0	27.0
Magnesium	mg/l	7.0	6.0	5.5
Potassium	mg/l	0.5	0.5	0.5
Sodium	mg/l	1.0	1.1	1.1
Fluoride	mg/l	---	0.08	0.12
Nutrients				
Orthophosphate	mg/l	0.03	0.03	0.028
Total Dissolved Phosphate	mg/l	0.04	0.04	0.03
Total Phosphorus as PO_4	mg/l	BDL[d]	BDL	0.045
Nitrate (as N)	mg/l	0.14	0.22	0.07
Ammonia	mg/l	BDL	BDL	0.06
Dissolved Silica (SiO_2)	mg/l	5.0	5.0	4.9
Bio-organic Parameters				
Chemical Oxygen Demand (COD)	mg/l	4.0	1.4	3.0
Biochemical Oxygen Demand (BOD)	mg/l	2.0	1.4	1.0
Total Organic Carbon	mg/l	---	1.0	3.0
Total Coliform	organisms/100 ml	30	38	40
Fecal Coliform	organisms/100 ml	1	1	4

TABLE A-1 Continued

	Unit of Measure	Sampling Station		
		Canyon Creek	Columbia Falls	Bigfork
Metals[e]				
Aluminum	mg/l	26.0(3)[e]	27.0(1)	73.0(13)
Arsenic	mg/l	4.5(2)	5.0(1)	1.5(17)
Barium	mg/l	0.0(1)	0.0(1)	17.6(17)
Beryllium	mg/l	0.0(1)	0.0(1)	0.0(8)
Boron	mg/l	8.7(1)	15.7(106)	21.7(18)
Cadmium	mg/l	0.0(2)	0.0(1)	0.059(17)
Chromium	mg/l	10.0(1)	0.0(1)	0.0(3)
Cobalt	mg/l	0.5(2)	0.0(1)	0.39(18)
Copper	mg/l	0.5(2)	17.0(1)	6.9(15)
Iron	mg/l	13.5(2)	15.0(1)	20.3(18)
Lead	mg/l	0.0(2)	0.0(1)	0.06(16)
Manganese	mg/l	5.0(2)	0.0(1)	16.5(13)
Mercury	mg/l	0.0(1)	---	0.033(3)
Molybdenum	mg/l	3.0(1)	6.0(1)	1.7(16)
Nickel	mg/l	0.0(1)	0.0(1)	1.1(16)
Selenium	mg/l	2.0(2)	4.0(1)	2.84(16)
Silver	mg/l	0.0(1)	0.0(1)	0.19(16)
Strontium	mg/l	130.0(1)	130.0(1)	141.0(16)
Vanadium	mg/l	---	---	0.28(16)
Zinc	mg/l	10.0(1)	---	13.5(15)
Pesticides				
Dieldrin	ug/l	BDL[d]	BDL[d]	.0037
DDT	ug/l	BDL[d]	BDL[d]	.0022

[a]Ranges are given, instead of average
[b]Jackson turbidity units
[c]Platinum-cobalt units
[d]Below detectable limits
[e]The number of analyses is shown in parentheses to the right of the average value.

Specific conductivity averages about 205 micro-mhos/cm at the Canyon Creek station, a high reading which reflects the carbonate geologic conditions in the headwaters of the North Fork. Specific conductivity, largely a function of geologic conditions, is remarkably constant throughout the year; however, spring runoff conditions cause conductivity levels to drop as much as 30 percent below average values. Specific conductivity at Columbia Falls ranges between 135 and 210 micro-mhos/cm, averaging 175, about 13 percent lower than average values measured on the North Fork, possibly due to less water-soluble geologic conditions along the Middle and South forks. Specific conductivity near Bigfork ranges from 140 to 250 micro-mhos/cm, averaging about 180, essentially the same as the Columbia Falls station.

Turbidity, total suspended solids, and organic color are usually low, reflecting the clear water conditions which prevail most of the year. However, in May and June, during spring runoff, turbidity increases and has been measured in the North Fork at 25 Jackson Turbidity Units (JTU) with total suspended solids approaching 50 mg/l. The nearby Middle Fork Flathead River is usually more turbid; recent analyses during spring runoff have shown turbidity up to 1,000 JTU and total suspended solids as high as 320 mg/l. The South Fork Flathead River, discharging from Hungry Horse Reservoir, dilutes the combined effects of the North Fork and Middle Fork with its consistently low values for turbidity. Turbidity at Columbia Falls has been measured as high as 75 JTU and probably is much higher on occasions during peak runoff. Organic color averages 3 Platinum-Cobalt units (P-C units) at Columbia Falls, but has been measured as high as 48 P-C units. The downstream station at Bigfork records similar fluctuations in turbidity, total suspended solids, and organic color during spring runoff. These parameters are all highly variable, fluctuating primarily with discharge rate. Insufficient data are available to critically compare the Bigfork station with the upstream stations.

Total dissolved solids (calculated) in the North Fork at the Canyon Creek gaging station average about 160 mg/l, with an overall range of 100 to 200 mg/l. This is a fairly low level and characterizes a rather unproductive (oligotrophic) aquatic system. Total dissolved solids at Columbia Falls average about 140 mg/l, lower than the average for the North Fork, suggesting that the main Flathead River is even less biologically productive than the North Fork. The South and Middle forks have average total dissolved solids levels of 117 and 155 mg/l, respectively. The Flathead River near Bigfork averages about 135 mg/l of total dissolved solids, essentially the same as the Columbia Falls station.

Chemical Parameters

The North Fork is classified as a bicarbonate-type stream, typical of waters in northwestern Montana. Bicarbonate levels at the Canyon Creek station are moderately high, averaging 119 mg/l, while carbonate levels are negligible. The Columbia Falls and Bigfork stations have an average bicarbonate level of about 103 mg/l while carbonates are lacking. These values are about 13 percent lower than those for the North Fork.

Chloride and sulfate levels are relatively low in the North Fork, with chloride averaging 0.4 mg/l and sulfate averaging 10 mg/l. At Columbia Falls and near Bigfork, chloride concentrations average 0.5 mg/l, similar to the North Fork. Sulfate values are lower at Columbia Falls than the North Fork, averaging about 4 mg/l, but increase slightly near Bigfork to an average of 6.5 mg/l.

These low sulfate concentrations in the Upper Flathead River Basin could be increased as a result of coal mining activity. Tests of the bituminous coal proposed for mining at the Cabin Creek mine site have revealed low sulfate concentrations (.4-.8 percent). But, if in fact measurable quantities of sulfate entered the North Fork, a series of events could happen. First, the sulfates could increase the acidity of the river. Since the North Fork has a low buffering capacity (pH ranging from 7.3 to 8.3), its potential to absorb toxic metals would increase. This chain reaction could be carried into the biological community through the accumulation of metals in benthic insects and finally in the indigenous fish species.

Alkalinity averages about 100 mg/l at Canyon Creek, characterizing the North Fork water as mildly alkaline. Alkalinity levels such as these, in conjunction with the pH values of 7 and 8, are considered beneficial for the support of diverse aquatic life. High alkalinity serves as a buffer to prevent sudden pH changes in the stream. Alkalinity values at Columbia Falls and Bigfork averaged 86 and 88 mg/l, respectively, about 14 percent lower than the North Fork, characterizing the main Flathead River as low in alkalinity.

Total hardness levels in the North Fork at Canyon Creek average about 100 mg/l, characterizing the water as between "soft" and "moderately hard." Calcium averages about 30 mg/l and magnesium about 7 mg/l which are both low, posing no problems to aquatic life or commercial use of the water. Total hardness levels at Columbia Falls and Bigfork are statistically indistinguishable; an average of 87 mg/l, 13 percent lower than the average hardness of the North Fork waters, characterizes the river water as "soft." Calcium and magnesium values were also low, averaging 25 and 6 mg/l, respectively, at Columbia Falls, and 27 and 5.5. mg/l, respectively, near Bigfork.

Potassium and sodium values on the North Fork averaged about 0.5 and 1.0 mg/l, respectively. At Columbia Falls and near Bigfork, potassium and sodium values averaged 0.5 and 1.1 mg/l, almost identical to averages on the North Fork. These values characterize the river as an oligotrophic aquatic system.

Fluoride levels measured at Columbia Falls and near Bigfork averaged 0.08 and 0.12 mg/l, respectively. The comparison of the two stations is not statistically valid for fluoride because the Columbia Falls data is based on over 100 tests while the Bigfork data is based on only 14 tests. The only known substantial source of fluoride in the basin is the aluminum reduction plant at Columbia Falls.

A brief review of the chemical parameters reveals a persistent 13 percent reduction of values between the Canyon Creek sampling station on the North Fork and the Columbia Falls sampling station, apparently resulting from dilution. This dilution factor continues to prevail as far down river as the Bigfork sampling station on Flathead River (three miles north of Flathead Lake).

Nutrients

Nutrient levels were moderately low in the North Fork at the Canyon Creek station and main Flathead River at Columbia Falls. Orthophosphate levels were normally less than the detectable level of 0.03 mg/l, but total dissolved phosphate averaged 0.04 mg/l. Total phosphorus (expressed as PO_4), while below detectable limits approximately half the time, ran as high as 0.09 mg/l at Canyon Creek and 0.07 mg/l at Columbia Falls on some occasions, particularly during spring runoff. These moderately low phosphorus levels are associated with high flow rates, which should dilute the actual concentration per unit time. It has been estimated that an average of 430 lbs/day of total phosphorus (as PO_4) is produced by the North Fork, a high figure which may be influenced by logging activity in the drainage. The Middle Fork Flathead River is of similar size but, having less logging activity, produces only an estimated 190 lbs/day total phosphorus (as PO_4). The main Flathead River reflects slightly lower total phosphorus (as PO_4) concentrations than the North Fork, suggesting that the North Fork is supplying more than its proportional share of the downstream phosphorus. The Flathead River at Columbia Falls carries an estimated 1300 lbs/day total phosphorus (as PO_4) downstream, most of it during spring runoff.

Phosphorus and nitrogen compounds in the Flathead River have been analyzed at the Bigfork station probably more than any other location in the drainage. The widespread concern over the possible eutrophication of Flathead Lake has resulted in the accumulation of a respectable bank of nutrient data. Unfortunately there is some confusion in reporting phosphorus compounds, and one is not always certain the data has been printed correctly. For example, three kinds of phosphate are commonly analyzed, and each of these may be expressed as P or as PO_4, with a difference factor of approximately three.

Phosphorus levels are of primary concern to Flathead Lake, as it has been demonstrated that this is the nutrient controlling algae growth. The existing data includes DHES data (1973-1974) and National Eutrophication Survey data (1974-1975), which are in fairly close agreement, and an earlier set of U.S. Geological Survey data (1969-1971) which lists phosphorus concentrations at considerably higher levels. There is no known reason that phosphorus levels should have dropped after 1971. It is suspected, but cannot be verified, that the 1969-1971 data might have been improperly reported as P rather than as PO_4, and that all values recorded in that study should be lowered by a factor of three. For the purpose of this analysis, both sets of data will be presented.

Total phosphorus (as PO_4) levels at Bigfork averaged about 0.045 mg/l, substantially higher than at Columbia Falls. (The earlier data indicates an average total phosphorus (as PO_4) level of 0.21 mg/l, which is over four times as high). Total dissolved phosphate (as PO_4) levels averaged about 0.03 mg/l (earlier data averaged about 0.08 mg/l). Orthophosphate (as PO_4) levels were near detectable limits, averaging 0.028 mg/l (earlier data averaged 0.040 mg/l). As discussed earlier, the discrepancies in these phosphate data are confusing, but using even the most conservative figures, it appears that there is a substantial increase in phosphate levels between Columbia Falls and the Bigfork station. Separate analyses have shown that this increase is only due in small part to sewage plant discharges, and it is presently thought that most of the increase must be due to agricultural activities. More analysis is needed for verification.

Nitrogen compounds are of less concern in the drainage, as it has been shown that downstream Flathead Lake's algal situation is aggravated primarily by the phosphorus compounds. With the exception of two grab samples on the North Fork, ammonia concentrations were found to be below detectable limits, and are of little concern at this time. Nitrate levels were found to average 0.14 mg/l at the Canyon Creek station. While this is lower than levels usually associated with eutrophication problems, 0.14 mg/l is perhaps a little higher than one would expect in the North Fork. No explanation is offered at this time.

Nitrate (as N) levels have varied from 0.00 to 0.20 mg/l, with an average of 0.07 mg/l for more than 60 analyses. Nitrite (as N) levels are lower, with values ranging between 0.00 and 0.02, and with an average of about 0.003 mg/l for 52 analyses. As might be expected, nitrate and nitrite (as N) averages 0.07 mg/l; the nitrite contribution is too small to affect the total significantly. Ammonia (NH_4 as N) averaged 0.06 mg/l (43 tests) with a maximum recorded value of nearly 0.40 mg/l. Organic nitrogen (as N) averaged 0.09 mg/l for 25 analyses, and Kjeldahl nitrogen (as N) averaged 0.47 mg/l over 15 analyses. Most of these nitrogen compounds were not systematically analyzed at the upstream stations, so comparisons cannot be made. One exception is nitrate, which was found to be lower at the Bigfork station than at Columbia Falls, but which was analyzed much more frequently at the lower station. Average ammonia levels were low and of little concern, but the occasional high readings up to 0.40 mg/l are disturbing, as such levels could be toxic to fish when associated with a pH level over 8.0. Nitrite, organic nitrogen, and Kjeldahl nitrogen levels were relatively low.

The average concentration of dissolved silica was 5 mg/l from four samples each at the Canyon Creek and Columbia Falls stations. Dissolved silica values near Bigfork on the Flathead River averaged 4.9 mg/l. Dissolved silica is a nutrient necessary to the growth of diatoms and will support such growth if in excess of about 0.5 mg/l. Obviously, silica levels are well above this lower limit; therefore the limiting factor for diatoms must be some other nutrient, perhaps nitrate.

Bio-Organic Parameters

Chemical oxygen demand (COD) and biochemical oxygen demand (BOD) at the Canyon Creek station average about 4 and 2 mg/l, respectively. COD and BOD values at Columbia Falls each average about 1.4 mg/l. Near Bigfork COD averages about 3 mg/l and BOD averages about 1 mg/l. These values are typical of unpolluted, free-flowing waters in western Montana and indicate a general lack of organic contamination in the entire river.

Total organic carbon was not tested on the North Fork but at Columbia Falls averaged about 1 mg/l and a little over 3 mg/l near Bigfork. These values are low, again indicating low organic content of the water. While the Bigfork average values appear to be higher than at Columbia Falls, it should be noted that the upstream value is based on only three samples.

At the Canyon Creek station, total coliform organisms averaged about 30 per 100 ml, but those coliform associated with a mammalian source (fecal coliform) averaged less than 1 organism per 100 ml, indicating a lack of sewage pollution in the North Fork. At Columbia Falls total coliform organisms averaged 38 per 100 ml, while fecal coliform averaged 1 organism per 100 ml; this is slightly higher than in the North Fork but still indicates that there is little sewage influence on the Flathead River. Total and fecal coliform averaged around 40 and 4 organisms per 100 ml, respectively, near Bigfork. This substantially higher average for fecal coliform is probably the result of discharges from three municipal sewage plants and of runoff from livestock wastes between Columbia Falls and the Bigfork station. The highest fecal coliform reading at Bigfork was 33 organisms per 100 ml, showing substantial contamination on at least one occasion.

Metals

Most metals analyses showed concentrations below detectable limits on the North Fork at Canyon Creek. Cadmium, zinc, arsenic, lead, and mercury were routinely found to be near or below detection limits, and no anomalies were noted. In addition, one or two analyses were made of 13 other metals. Of these, the following may be found in detectable concentrations:

Aluminum, total	0.060 mg/l
Chromium, dissolved	0.010 mg/l
Cobalt, total	0.050 mg/l
Manganese	0.010 mg/l
Strontium	0.130 mg/l

None of these metals are present in concentrations sufficient to cause any known problems. Cobalt may be a biological stimulant in concentrations as low as 0.0005 mg/l, but as with any nutrient, it alone cannot cause biological growth unless all necessary nutrients are present in at least threshold levels.

In addition, other detectable levels of common metals were found as follows:

Iron - variable, once as high as 0.37 mg/l
Copper - usually above detectable limits, but not exceeding 0.02 mg/l

Iron can cause staining and precipitation problems in domestic water supplies when present in concentrations exceeding 0.3 mg/l. One analysis out of nine exceeded this level, and all others were well below this threshold concentration.

Metals in the waters of the Flathead River at Columbia Falls and near Bigfork were in most cases, below detectable limits; there were no anomalies. Table A-1 on page 85 presents a list of seventeen metals analyzed at the Canyon Creek, Columbia Falls, and Bigfork stations. The number of analyses for each metal is shown in parentheses to the right of the values.

Pesticides

In July of 1970, single samples at Canyon Creek and Columbia Falls were analyzed for thirteen pesticides. None of these were present in detectable concentrations. Nine pesticides were analyzed on eleven occasions each near

Bigfork. All were found in detectable concentrations. This is to be expected, as most pesticide use is confined to the lower valley areas. Pesticides were not found in alarming concentrations. The two most substantial pesticide concentrations are Dieldrin at an average of 0.0037 ug/l and DDT at 0.0022 ug/l.

Flathead Lake

Water quality studies on Flathead Lake were extensively surveyed by Seastedt and Tibbs (1974). Their review noted that the lake has been the subject of many ecological studies which consider the lake's chemical and physical characteristics as influences on the biological communities. Morgan (1970) summarizes water chemistry data accumulated since 1929. Unfortunately, his summary is not a statistically valid comparison because of the variation in sampling techniques. However, Seastedt and Tibbs (1974) support the belief that a trend of increased nutrients (ammonia, nitrate nitrogen, and orthophosphate) values is occurring. It has not been determined whether the lake has experienced a corresponding increase in aquatic productivity.

Flathead Lake was first classified by Howard (1929) and Young (1935) as an oligotrophic mountain lake. The Montana Department of Fish and Game (MDFG 1976) states that the water chemistry parameters have not notably changed since these first investigations. Net phytoplankton species composition and low phosphorus values in the lake have also led Tibbs et al. (1975) to characterize Flathead Lake as oligotrophic.

Recent water chemistry analyses, substantiating these conclusions, have been conducted by the Montana Department of Fish and Game (Hanzel 1970) and the University of Montana Biological Station (Tibbs et al. 1975). MDFG (1976) emphasizes that Flathead Lake contains at least six macroenvironments defined by physical characteristics. While the waters of the lake are one distinct unit, several physical variations between the bays, narrows, open lake, and north, south, east, and west extremes exist. From these physical variations, the Department of Fish and Game designated eleven sampling locations (figure 10) in 1966 (Hanzel 1970). Chemical parameters analyzed at each of these stations were limited to measurement of pH, alkalinity, dissolved oxygen, and standard conductance. Samples were collected seasonally at the surface and at fifty feet. It was found that water chemistry parameters have not significantly changed since the first investigations of the lake over 45 years ago. This sampling program was conducted in conjunction with a detailed investigation of the fisheries in Flathead Lake. The conclusion drawn was that no distinct restrictions were placed by chemical parameters on fish movements and distribution (MDFG 1976).

Recently, extensive water chemistry sampling of Flathead Lake was conducted by Tibbs et al. (1975). Thirteen stations (ten on the lake and one each on inflowing and outflowing rivers--see figure 10) were sampled as often as possible from September 1973 to August 1974. Table A-2 contains a summary of parameters sampled and their range of values over the entire lake throughout the year.

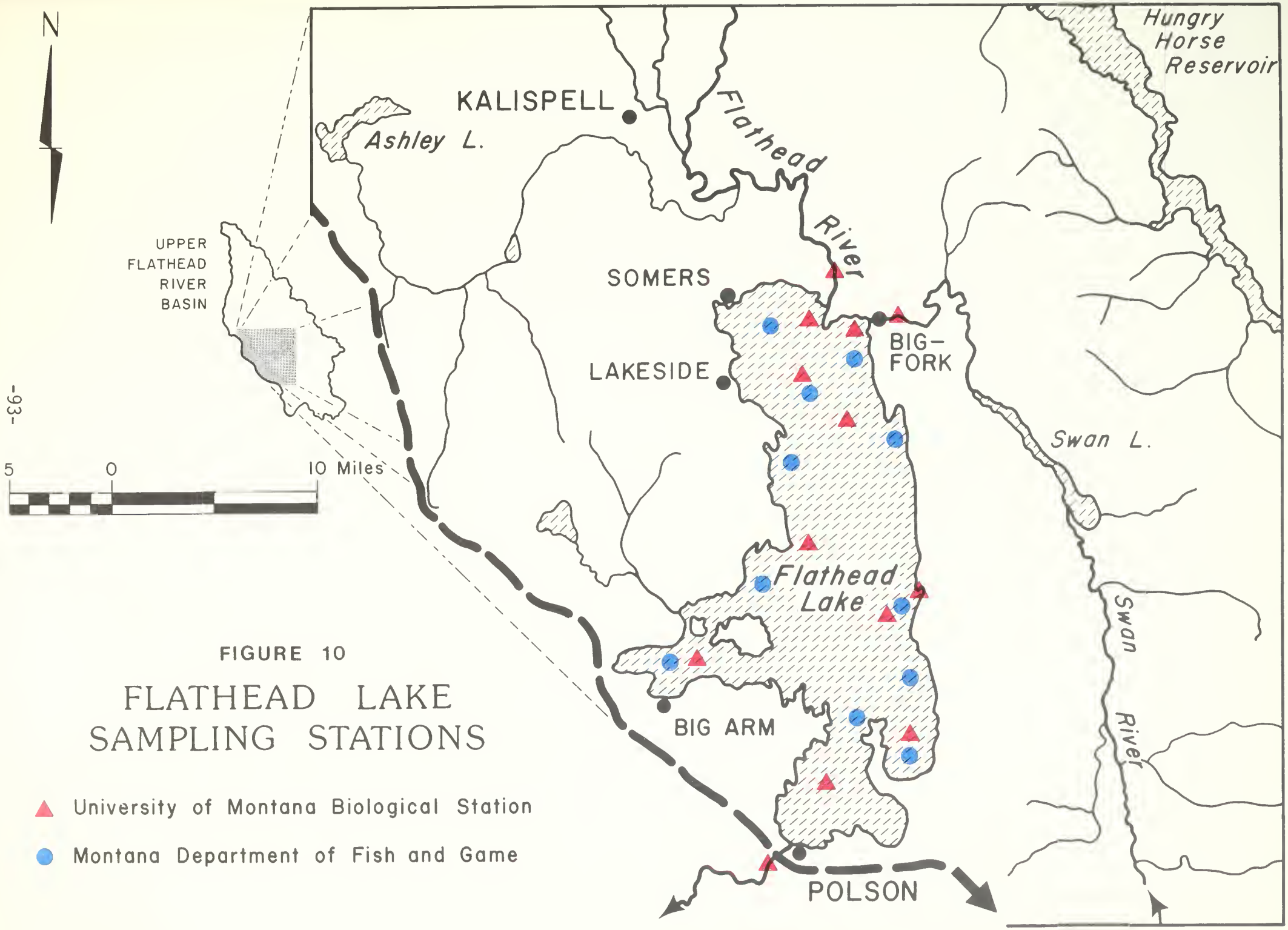


FIGURE 10

FLATHEAD LAKE
SAMPLING STATIONS

The physical characteristics of Flathead Lake are similar to those of a deep, cold mountain lake with spring and fall turnover throughout the water column. Stratification begins in late April and early May and is followed by the development of a summer thermocline, usually in June. The thermocline gradually sinks, and by November the water mass turns over. The lake is generally the same temperature throughout at about 36°F from late January to early April. The only exceptions are the more shallow areas, such as Polson Bay, where the water is the same temperature throughout for the entire year. In February 1962 and 1968, Flathead Lake was entirely ice-covered.

High turbidity values are a result of high annual spring runoff in May and June. Light normally becomes extinguished at 75.5 feet, but Secchi disk readings for light penetration have shown less than three feet of light penetration. The turbid river water does not disperse evenly within the lake (Tibbs 1975); rather, the turbid river water and clear lake water strongly resist mixing. An interface is developed where the warmer river water slides over the colder, clear water and gradually migrates down the lake. Mixing resistance slows movement of the turbid water into the deeper water of the eastern half of the lake, with Yellow Bay one of the last areas to become turbid. The surface waters are generally clear by early August following the gradual settling or dispersal of clay particles. By late August, the lake is usually blue in color again.

The physical parameters analyzed were dissolved oxygen, conductivity, pH, and oxidation-reduction potential (ORP) at the ten lake stations at depths up to 328 feet. Analysis indicated constant lake-wide readings.

Chemical parameters measured were alkalinity, hardness, and carbon dioxide; Flathead Lake water is well buffered and moderately hard.

Nutrients investigated included nitrogen and phosphorus compounds, silica, and total carbon. Nitrate values ranged between 0.01 and 0.40 mg/l at lake stations; the high values were generally recorded during spring and fall circulation at all stations on the lake. Phosphorus values were rarely above minimum detectable limits at the lake stations. Total carbon values were low as expected, considering the low net phytoplankton counts obtained. Silica (SiO_2) values have ranged from 1.3 to 2.5 mg/l during winter and spring months and 6.0 to 7.0 mg/l during June and July.

Phosphorus is the limiting nutrient to algal growth in Flathead Lake. Tibbs et al. (1975) present a nutrient budget for the lake as evidence. About two-thirds of the nitrate (as N) and total phosphorus entering Flathead Lake was not discharged at Polson. It is believed this two-thirds is organically bound or settled out in the lake. All of the phosphorus discharged at Polson is believed to be organically bound in living phytoplankton biomass, whereas only two-thirds of the nitrogen discharged was organically bound. This display of inorganic nitrogen being discharged from the lake indicates the dependence of algal growth on another nutrient. Likewise, silica and trace metals appear to be present in sufficient amount to not be limiting to phytoplankton production. Phosphorus entering the lake appears to be in sufficient concentration to support additional phytoplankton biomass, regardless of the controversy over the validity of some phosphorus data and its recording (Nunnallee 1976). Chemical and physical hydrodynamics are offered as explanations for the loss of phosphorus availability for phytoplankton production. First, dissolved

TABLE A-2

SUMMARY OF WATER CHEMISTRY DATA FOR FLATHEAD LAKE
FROM SEPTEMBER 1973 TO AUGUST 1974

PARAMETERS	RANGE
Physical Parameters	
Dissolved Oxygen, % saturation	80-110
pH	7.8-8.1
Conductivity, micro-mhos/cm	155-170
ORP, millivolts	3.7-5.7
Common Parameters	
Alkalinity, mg/l	77-91
Hardness, mg/l	83-98
Nutrients	
Nitrate (as NO_3), mg/l	0.01-0.40
Phosphate (as PO_4), mg/l	<.03
Silica (SiO_2), mg/l	1.8-5.1
Metals	
Copper, mg/l	BDL[a]
Cobalt, mg/l	BDL
Zinc, mg/l	BDL
Manganese, mg/l	BDL
Cadmium, mg/l	BDL

SOURCE: Tibbs, Gaufin, and Stanford 1975.
[a]Below detectable levels.

iron has been shown to exist in moderate quantities. Phosphorus will combine with the dissolved iron and precipitate out as iron phosphate under aerobic conditions. As long as iron is available, phosphate could be precipitated and settle to the bottom of the lake.

Secondly, phosphorus is known to be absorbed to the surface of the fine clay particiles. The Upper Flathead River contributes high levels of montmorillonite and kaolinite clays in the turbid spring runoff waters. Through phosphorus sorption by the clays and eventually settling of the clay, the phosphorus could be lost to the lake sediments,a theory supported by a similar reduction in phytoplankton production during the same period. This process may be the most important factor in maintaining the lake's clear

color during later summer, fall, and winter. No estimate has been offered of the amount of phosphorus the lake might assimilate before changes would occur in algal production or species composition.

Copper, cobalt, zinc, manganese, and cadmium concentrations were always low, but detectable.

CURRENT WATER QUALITY DATA FOR THE FLATHEAD BASIN

The North Fork Flathead River, from October 1, 1975, to September 30, 1976, was sampled for chemical, biological, and physical data. The framework for this sampling program is a product of the North Fork Interagency Technical Committee established to develop a baseline level of information on the North Fork Flathead River prior to Canadian Cabin Creek coal mining.

Physical, Chemical and Bio-Organic Parameters, Nutrients,and Metals

The North Fork Flathead River is presently gaged at the Montana-Canada border by the U.S. Geological Survey for a number of chemical and biological parameters. The Flathead Drainage 208 project upgraded this station by adding additional chemical parameters and providing partial funding for the sediment station. Table A-3 lists both chemical and biological parameters to be examined and their sampling frequency. The first seven parameters have been added to the border station through the Flathead Drainage 208 Project funding while the remaining parameters are presently being collected and analyzed by the U.S. Geological Survey.

Beginning on October 1, 1975, the U.S. Geological Survey established a quality station below the mouth of Canyon Creek on the mainstem of the North Fork Flathead River. This station will measure the same parameters as the border station.

The Flathead Drainage 208 Project and the Montana Department of Fish and Game collected chemical data on 11 Whitefish Range tributaries at their headwaters and mouths, and at sampling stations near Polebridge on the North Fork Flathead River and on Bowman Creek. The stations, creeks being sampled, their locations, and a description of the stations are presented in table A-4 and shown on figure A-11.

Sampling began on October 1, 1975, with the collection of samples for the following chemical parameters:

1. Polebridge, Bowman Creek, and Whitefish Range Tributary mouths. Monthly samples for alkalinity, aluminum, ammonia, bicarbonate, calcium, carbonate, dissolved oxygen, dissolved solids (calculated), fluoride, hardness, iron, magnesium, manganese, mercury, nitrate, nitrite, pH, total dissolved phosphate, phosphate (total),potassium, silica, sodium, specific conductivity, sulfate, turbidity, and zinc.

TABLE A-3

PARAMETERS CURRENTLY BEING SAMPLED ON THE NORTH FORK FLATHEAD RIVER

Station	Frequency	Parameters
Border (USGS 12355000)	Daily	Suspended sediment
Canyon Creek (USGS 12355500)	Monthly	Acidity, ammonia
	Quarterly	Aluminum (total and dissolved), organic carbon (suspended and dissolved)
Canyon Creek	Continuously	Discharge
	Instantaneously	Discharge
	Daily	Conductance, water temperature
	Monthly	Bicarbonate, calcium (dissolved), carbonate, chloride (dissolved), dissolved oxygen, dissolved solids (sum), fecal coliform and streptococci, hardness (total and noncarbonate), magnesium (dissolved), nitrate and nitrite (total), nitrogen (Kjeldahl), pH, phosphorus (total), phytoplankton, potassium (dissolved), residue evaporation (at 180°), silica (dissolved), sodium (dissolved), sulfate (dissolved), turbidity (JTU)
	Quarterly	Arsenic (dissolved and total), cadmium (dissolved), chromium (dissolved and total), cobalt (dissolved and total), copper (dissolved and total), iron (dissolved and total), lead (dissolved and total) manganese (dissolved and total), mercury (dissolved and total), selenium (dissolved and total), zinc (dissolved and total)

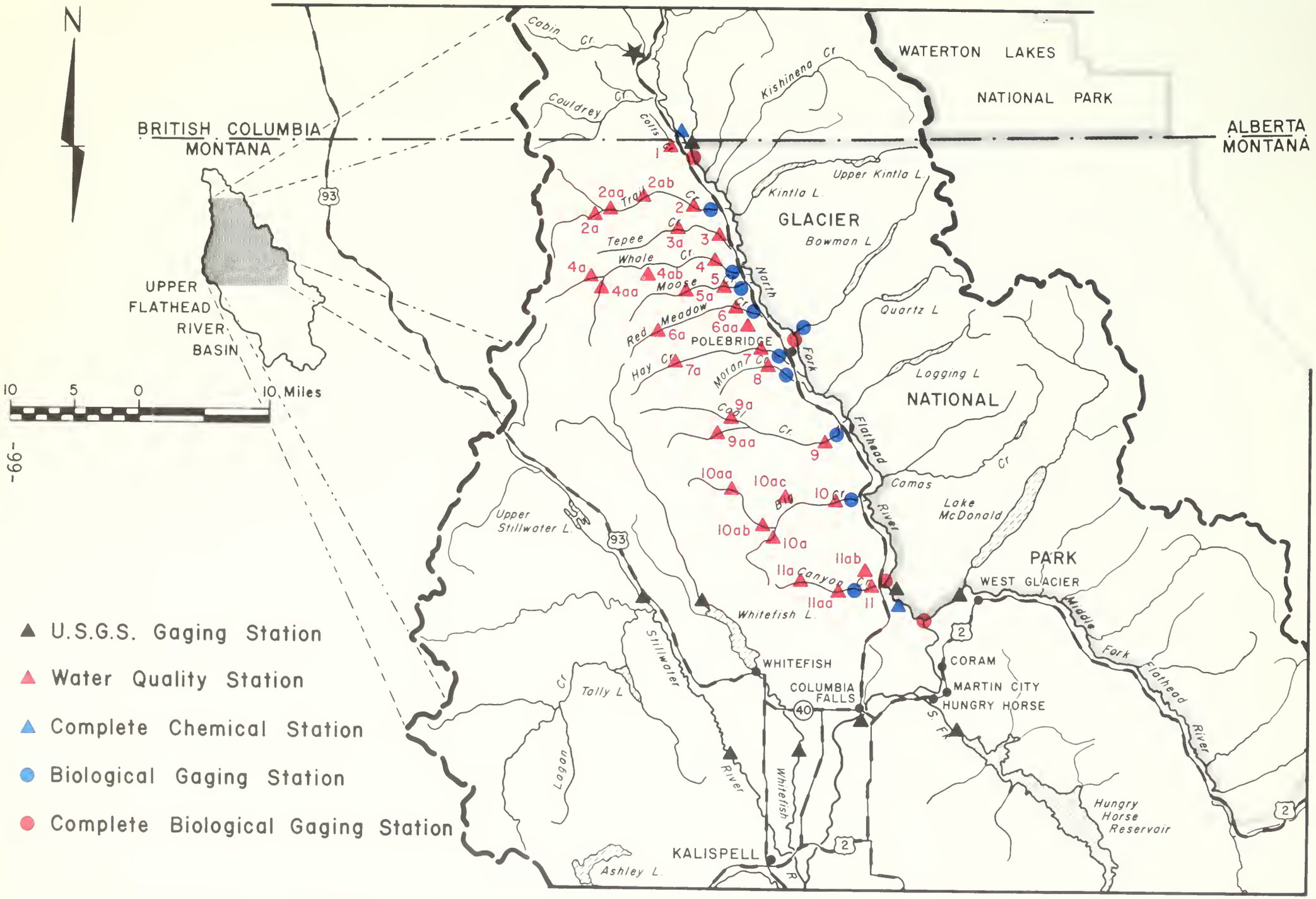
2. Whitefish Range Tributary headwaters. Semiannually--same parameters as above. On May 1, 1976, the following parameters were dropped from all stations for the remainder of the sampling period because previous samples were below detectable limits: ammonia, fluoride, lead, manganese, mercury, nitrite, phosphate (total), and zinc.

During the month of September 1976, a one-time semiquantitative spectral scan was run of samples from each station identified above.

TABLE A-4

SAMPLING CODE

STATION	CREEK	LOCATION	DESCRIPTION OF STATION
1	Colts Creek	S 8 T 37 N R 22 W	Near mouth at North Fork Road
2	Trail (Yakirikak)	S 35 T 37 N R 22 W	Near mouth at North Fork Road
2-a	Trail	S 33 T 37 N R 23 W	Above mouth of Tuchuck Creek
2-aa	Tuchuck	S 33 T 37 N R 23 W	At mouth
2-ab	Thoma	S 36 T 37 N R 23 W	At mouth
3	Teepee	S 11 T 36 N R 22 W	Near mouth at North Fork Road
3-a	Teepee	S 7 T 36 N R 22 W	At bridge crossing
4	Whale	S 30 T 36 N R 21 W	Near mouth at North Fork Road
4-a	Whale	S 29 T 36 N R 23 W	Above mouth of Shorty Creek
4-aa	Shorty	S 29 T 36 N R 23 W	At mouth
4-ab	Akinkokn	S 26 T 36 N R 23 W	At bridge crossing near mouth
5	Moose	S 31 T 36 N R 21 W	Near mouth at North Fork Road
5-a	Moose (upper)	S 5 T 36 N R 22 W	Upper Moose Creek
6	Red Meadow	S 7 T 35 N R 21 W	Near mouth at North Fork Road
6-a	Red Meadow	S 24 T 35 N R 23 W	Below Red Meadow Lake
6-aa	South Fork Red Meadow	S 7 T 35 N R 21 W	At mouth of South Fork Red Meadow
7	Hay	S 34 T 35 N R 22 W	Near mouth at North Fork Road
7-a	Hay	S 32 T 35 N R 22 W	Upper Hay Creek
8	Moran	S 2 T 34 N R 21 W	Near mouth at North Fork Road
9	Coal	S 20 T 34 N R 20 W	Near mouth at North Fork Road
9-a	Coal	S 24 T 34 N R 22 W	Upper Coal above mouth of South Fork Coal Creek
9-aa	South Fork Coal	S 22 T 34 N R 22 W	Mid-section
10	Big Creek	S 22 T 33 N R 20 W	Near mouth at North Fork Road
10-a	Big Creek	S 5 T 32 N R 21 W	Above mouth Hallawat Creek
10-aa	Kletomus	S 25 T 33 N R 22 W	At mouth
10-ab	Hallawat	S 33 T 33 N R 21 W	At mouth
10-ac	Elelehum	S 26 T 33 N R 21 W	At mouth
11	Canyon	S 27 T 32 N R 20 W	Near mouth
11-a	Canyon	S 27 T 32 N R 21 W	Upper section
11-aa	Kimmerly	S 29 T 32 N R 20 W	At mouth
11-ab	Maginnis	S 27 T 32 N R 21 W	At mouth



NORTH FORK FLATHEAD RIVER SAMPLING STATIONS

FIGURE 11

Fish

The Montana Department of Fish and Game has established 13 Fish Population Sampling Stations in addition to the previously mentioned stations. Electro-shocking methods are utilized to determine what species exist and at what times of the year. This study is aimed at analyzing which species of fish use what Whitefish Range Tributaries for spawning or natural habitat.

Benthic Insects

Benthic insects were collected and identified by the Flathead Drainage 208 Project. Samples were collected four times during the year beginning in November 1975 and continuing in March, April, and August 1976. All samples gathered have been identified.

Four mainstem complete biological gaging stations were established at the following locations: U.S.-Canadian border, Polebridge and Canyon Creek on the North Fork, and one station on the Middle Fork near Blankenship Bridge. Quantitative and qualitative sampling techniques were utilized on the mainstem stations.

Quantitative samples were gathered with a Hess round square foot sampler equipped with a 350-micron mesh nitex netting. Seven samples were taken from each station to determine how many benthic insects inhabit a square foot area of the river bed.

Qualitative sampling of all habitats at each station in the river were also done using kick screens, dip net, etc. These samples aided in the detection of any species missing from previous samples and thus ensured a complete species list for the river.

Quantitative insect samples were collected at 11 tributary stations near each of their mouths (Colts, Trail, Whale, Moose, Red Meadow, Hay, Moran, Coal, Big, Canyon, and Bowman creeks). Samples were taken on the same days as those on the mainstem stations and in a similar manner, except that only four samples were taken at each station instead of seven. Changes in insect numbers per square foot or species present can indicate a change in water quality. In this way, the insect community can be used as a very sensitive indicator of water quality.

APPENDIX B

BUDGET DETAILS

BUDGET DETAILS

Estimated Expenditures Through November 30, 1976

Personal Services	
Salaries	$17,703.00
Benefits	2,260.00
Total Personal Services	19,963.00
Operating Expenses	
Contracted Services	6,157.00*
Communications	427.00
Travel	2.303.00
Rent	6.00
Total Operating Expenses	8,893.00
Equipment	
Office Furniture	362.00
Total Equipment	362.00
TOTAL PROGRAM	$29,218.00

*Includes $4,157.75 paid to the Flathead Drainage 208 Project in support of the water quality monitoring station near Canyon Creek; and $820.00 paid to the Montana Department of Fish and Game for analysis of biological data.

Proposed Expenditures - December 1, 1976 Through June 30, 1977

Personal Services	
Salaries	$ 4,000.00
Benefits	515.00
Total Personal Services	4,515.00
Operating Expenses	
Contracted Services	5,000.00*
Communications	400.00*
Travel	900.00
Rent	0.00
Total Operating Expenses	6,300.00
TOTAL PROGRAM	$10,815.00

*Includes $4,500.00 for publication of report and $200.00 for postage.

Total Estimated Expenditures	$29,128.00
Total Proposed Expenditures	10,815.00
Total Program Cost	$39,943.00
Total Appropriation	$47,500.00

APPENDIX C

HOUSE BILL 622

HOUSE BILL NO. 622

AN ACT TO APPROPRIATE FROM THE GENERAL FUND FORTY-SEVEN THOUSAND FIVE HUNDRED DOLLARS TO THE DEPARTMENT OF NATURAL RESOURCES FOR A STUDY OF THE NORTHERN PORTION OF FLATHEAD LAKE AND THE UPPER PORTION OF THE FLATHEAD RIVER DRAINAGE BASIN FOR THE BIENNIUM ENDING JUNE 30, 1977.

Be it enacted by the Legislature of the State of Montana:

Section 1. There is appropriated forty-seven thousand five hundred dollars ($47,500) from the general fund to the department of natural resources and conservation for a study of the northern portion of the Flathead Lake and the upper portion of the Flathead river drainage basin for the biennium ending June 30, 1977.

Section 2. The department of natural resources and conservation, in conjunction with the department of fish and game and other state agencies and institutions with relevant expertise, shall prepare the study for presentation to the forty-fifth legislature. The study shall:

(1) Compile and analyze all previous biophysical data pertinent to the hydrology and limnology of the northern portion of Flathead Lake and the upper portion of the Flathead river drainage basin.

(2) Estimate current allocations and levels of need for the water resources of this watershed and evaluate the probable effect that the existing water uses have upon the quality and quantity of water as well as the biophysical equilibrium of the land-stream-lake system.

(3) Evaluate as a function of location and time the probable impact upon the land-stream-lake system of the development of the Canadian Cabin Creek coal deposits and the attendant urbanization of this headwaters region, as well as the impacts arising from changes in domestic land-use and flood control.

(4) Synthesize data and contain a summary report and recommendations for the future.

Section 3. A reversion shall be made to the general fund in the amount of any federal funds received to carry out the purpose of this act.

Approved April 29, 1975.

Montana Session Laws 1975

APPENDIX D

PUBLIC LAW 94-486
THE WILD AND SCENIC RIVERS AMENDMENT

Public Law 94-486
94th Congress

An Act

To amend the Wild and Scenic Rivers Act, and for other purposes.

Oct. 12, 1976
[S. 1506]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

Wild and Scenic Rivers Act, amendments.

TITLE I—FLATHEAD, MONTANA

SEC. 101. Section 3(a) of the Wild and Scenic Rivers Act (82 Stat. 906; 16 U.S.C. 1271 et seq.) is amended by adding the following new paragraph at the end thereof:

16 USC 1274.

"(13) FLATHEAD, MONTANA.—The North Fork from the Canadian border downstream to its confluence with the Middle Fork; the Middle Fork from its headwaters to its confluence to the South Fork; and the South Fork from its origin to the Hungry Horse Reservoir, as generally depicted on the map entitled 'Proposed Flathead Wild and Scenic River Boundary Location' dated February 1976; to be administered by agencies of the Departments of the Interior and Agriculture as agreed upon by the Secretaries of such Departments or as directed by the President. Action required to be taken under subsection (b) of this section shall be taken within one year from the date of enactment of this paragraph. For the purposes of this river, there are authorized to be appropriated not more than $6,719,000 for the acquisition of lands and interests in lands. No funds authorized to be appropriated pursuant to this paragraph shall be available prior to October 1, 1977.".

Appropriation authorization.

APPENDIX E

RESULTS OF QUESTIONNAIRE ON WATER USE

The second task under Section 2 of HB 622 asks for an estimate of current water allocations and levels of need. Funding and time were not available to adequately determine the quantity of water adjudicated from the Flathead River. The most viable approach to the answering this question was the circulation of a questionnaire to those people who might be using water from the Flathead River system.

On July 15, 1976, the water use questionnaire was circulated to over 1,300 landowners who own property adjacent to or within one mile on either side of the North Fork and mainstem Flathead River above Flathead Lake. The cover letter and questionnaire are shown on the following pages.

Over 410 completed questionnaires were returned, represented a 32 percent response. The data from the questionnaires has been compiled and totalled into table C-1.

The circulation of questionnaires was an attempt to sample the whole set of people who could be using water from the Flathead River or water which is hydrologically connected to the Flathead River. The one-mile boundary was arbitrarily chosen and does not necessarily represent that area which is hydrologically connected to the river. The 32 percent return was estimated to represent a sample of one-third of the water use from the defined area.

The water use quantities in table 3 were multiplied by three to give a crude estimate of how much water is presently being used for what purpose, present needs, and future needs. These values are shown in tables 4 and 5 on pages 29 and 30 of the report.

TABLE C-1
RESULTS OF QUESTIONNAIRE ON WATER USE OF NORTH FORK
AND MAINSTEM FLATHEAD RIVER

Source (surface or ground)	Number of Withdrawal Points	Irrigation (No. of acres)		Domestic (No. of families)	Stock (type and No.)	Municipal (No. of people)	Industrial Uses (gal./year)	Present Need (Yes, No)	Future Need	
		Sprinkler	Other						(Yes, No.)	Total Amt.
180-S 230-G	410	5,696.77	75	266	2191 cows and horses 250 chickens 150 sheep 2 goats 479 hogs	1,146	3,340,600	21 yes 192 no	117 yes 112 no	13,054.04

MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

THOMAS L. JUDGE, GOVERNOR
GARY WICKS, DIRECTOR

WATER RESOURCES DIVISION
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449-2872
32 SOUTH EWING
NATURAL RESOURCES BUILDING
HELENA, MONTANA 59601

Please reply to:
Upper Flathead River
Basin Study
P. O. Box 244
Kalispell, MT 59901

Dear Sir:

I would like to ask you, as a landowner in the Flathead River basin, to participate in a study being conducted by the Department of Natural Resources and Conservation under Montana House Bill No. 622. Enactment of this bill resulted in large part from concern over the potential impacts from coal development along Cabin Creek in Canada.

Social, economic, and environmental impacts to Montana could be substantial, depending on the methods used to extract and transport the coal. Therefore these elements are being closely examined. The aquatic ecology is also being analyzed to help provide an understanding of the quality of the Flathead River water before coal development begins.

House Bill No. 622 specifies that present water use and current and future needs for the water resources of the Flathead River be estimated. You can assist in this task by answering the questions in the attached questionnaire to the best of your knowledge. A self-addressed, stamped envelope is provided for your convenience. Please return the completed form by August 1, 1976.

Your participation will help the timely completion of the study and allow us to make valid recommendations to the 45th Montana Legislature concerning the impacts of development in the upper Flathead River basin. The information requested is not for the purpose of adjudicating or determining water rights.

Thank you for your help.

Sincerely,

Hanley F. Jenkins, II
Resource Planner

HFJ/km
Encls.

QUESTIONNAIRE
WATER REQUIREMENTS IN THE FLATHEAD RIVER BASIN

1. Are you using surface or ground water in the upper portion of the Flathead River drainage basin? (See map on back)
_____Yes _____No

2. Check the source(s) of water used, and list the number of withdrawal points in the space provided in the right column.

_____Surface water. . . . . Number of points_____
_____Ground water . . . . . Number of points_____

3. Indicate the name of the stream and enter the legal land description of the approximate point(s) of withdrawal in the space provided. Plot each location on the map provided on the back of this questionnaire, using the letters below (a,b,c,d, etc.) Use additional pages if more space is needed.

Surface water
a. Name of stream_____
_____1/4,Section_____,Township_____N,Range_____W

b. Name of stream_____
_____1/4,Section_____,Township_____N,Range_____W

Ground water
c. Name of nearest stream_____
_____1/4,Section_____,Township_____N,Range_____W

d. Name of nearest stream_____
_____1/4,Section_____,Township_____N,Range_____W

4. Check the purpose(s) for which this water is used in the left column. For each purpose checked, enter the number of acres, families, stock, etc., and amount of water used in the spaces provided to the right.

USE (check those applicable)	QUANTITY	AMOUNT OF WATER USED AND UNIT OF MEASUREMENT
_____ Irrigation	.No. of acres: _____	_____
_____ Domestic	.No. of families:_____	_____
_____ Stock.	Type:_____Number:_____	_____
_____ Municipal.	.No. of people: _____	_____
_____ Industrial	.Type: _____	_____
_____ Other (name)	_____ _____	_____
_____ _____	_____ _____	_____

5. If you irrigate, check the type(s) of irrigation system(s) used and include the number of acres irrigated.
_____ Contour Ditch. . . . . .Acres:_____
_____ Border Dike. . . . . .Acres:_____
_____ Sprinkler. . . . . .Acres:_____
_____ Other (explain)_____ Acres:_____
_____ _____ Acres:_____

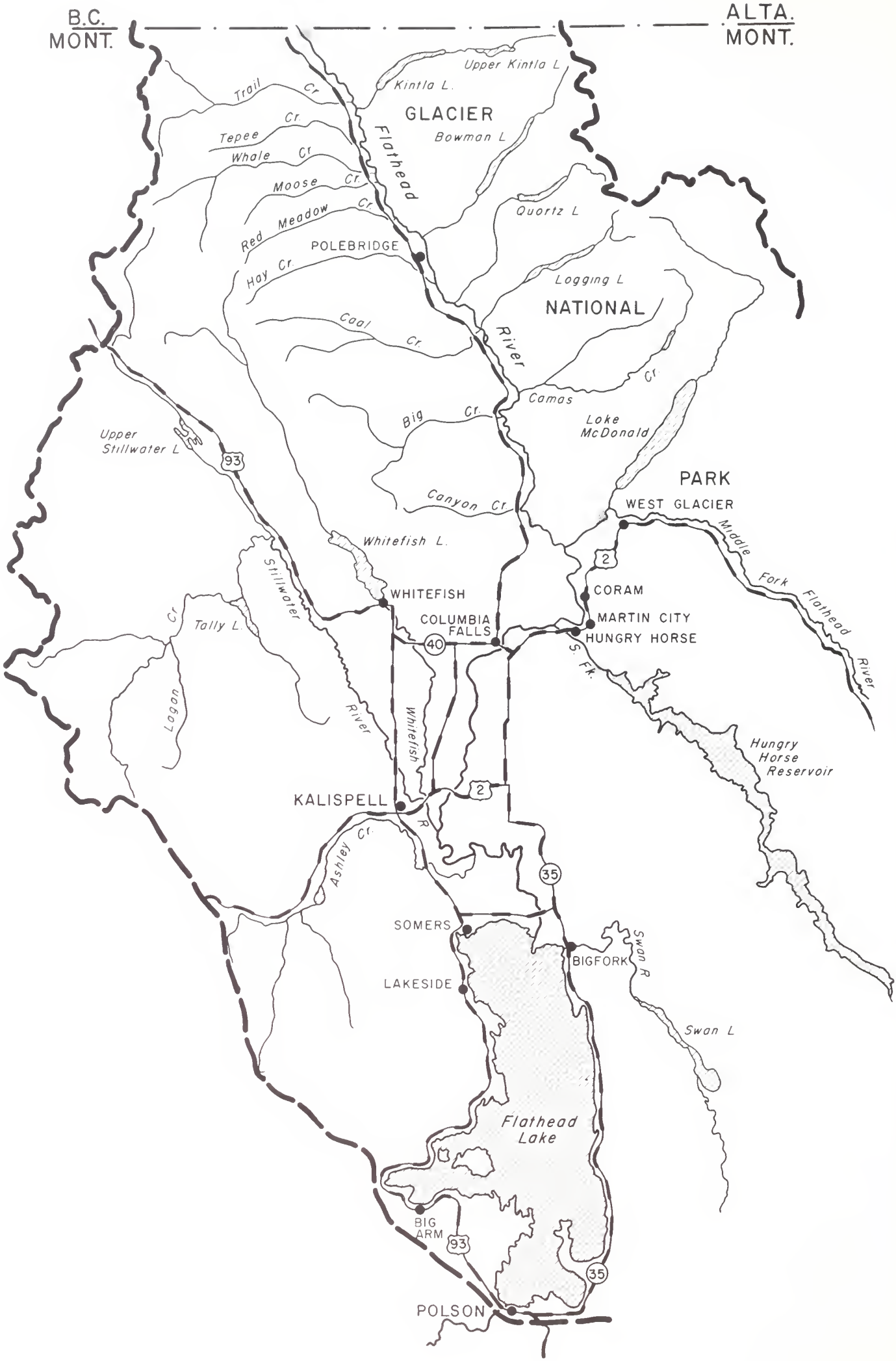
6. Do you need more water now? _____Yes _____No

7. If so, how much water is now required, and for what purposes(s)
Purpose_____Amount needed_____
Purpose_____Amount needed_____
Purpose_____Amount needed_____

8. Do you plan to increase your use of water in the future?
_____Yes _____No

9. If so, project your needs to the best of your ability over the next 20 years. Enter the purpose to which it will be put and the additional amount of water needed in the space provided, to the right of the corresponding years.

YEAR	PURPOSE	ADDITIONAL AMOUNT OF WATER
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____


B.C.
MONT.
ALTA.
MONT.
Upper Kintla L
Kintla L.
GLACIER
Bowman L
Trail Cr.
Tepee Cr.
Whale Cr.
Moose Cr.
Red Meadow Cr.
Hay Cr.
Flathead
Quortz L
POLEBRIDGE
Logging L
NATIONAL
Coal Cr.
River
Cr.
Camas
Big Cr.
Lake McDonald
Upper Stillwater L
93
PARK
Canyon Cr.
WEST GLACIER
Middle Fork Flathead River
Whitefish L.
2
Stillwater
WHITEFISH
CORAM
Tally L.
COLUMBIA FALLS
MARTIN CITY
HUNGRY HORSE
40
S. Fk.
Lagon Cr.
River
Whitefish
Hungry Horse Reservoir
KALISPELL
2
R
Ashley Cr.
35
SOMERS
BIGFORK
Swan R
LAKESIDE
Swan L
Flathead Lake
BIG ARM
93
35
POLSON

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GLOSSARY

Aerobic - Living, active, or occurring only in the presence of free oxygen.

Adfluvial - Fish which live their adult lives in a lake and migrate into smaller tributaries to spawn.

Aquatic - Growing, living in, or frequenting water.

Baseline - Existing at the present.

Biochemical Oxygen Demand (BOD) - The quantity of oxygen used in the biochemical oxidation of organic and/or inorganic matter.

Biomass - The total quantity at a given time of living organisms of one or more species per unit of space (species biomass), or of all the species in a community (community biomass).

Biophysical - Application of physical principles and methods to biological problems.

Carrying Capacity - The population that an area will support without undergoing deterioration.

Chemical Oxygen Demand - The quantity of oxygen used in the chemical oxidation of inorganic matter.

Cirque Basin - A deep steep-walled mountain basin which is shaped like half a bowl.

Climax - A type of community capable of perpetuation under the prevailing climatic and soil conditions.

Coliform - A species of bacteria found in the intestine of a man and all vertebrates.

Community - A group of populations of plants and animals in a given place.

Continental climate - Describes a climate in which weather patterns are generally not affected by the oceans.

Cretaceous - The last period of the Mesozoic Era approximately 65 million years ago.

Dissolved Oxygen (DO) - The oxygen dissolved in water, wastewater, or other liquid usually expressed in milligrams per liter (mg/l), or parts per million (ppm), or percent of saturation.

Ecosystem - A group of plants and animals and their nonliving environment which function as an ecological unit.

Effluent - outflow of used water.

Eocene - The epoch following the Paleocene epoch of the Tertiary period of geology, approximately 55 million years ago.

Eutrophication - The natural or man-caused addition of dissolved nutrients to water, resulting in increased growth of plants.

Exotic species - A species which is not native to the place where it is found.

Fluvial - Fish which live their adult lives in larger streams and move into smaller tributaries to spawn.

Hydrology - The science of the behavior of water in the atmosphere, on the earth's surface, and underground.

Indigenous - Native to an area; having originated in and being produced, growing or living naturally in a particular region or environment.

Interstitial Spaces - Very small spaces between gravel on a stream bottom.

Jackson Turbidity Unit (JTU) - A measure of turbidity, or lack of transparency, of water.

Jurassic - The middle period of the Mesozoic Era, approximately 135 million years ago.

Limiting factor - The productivity of an aquatic ecosystem is limited by the nutrient present in the least amount at any time. Quite frequently, this nutrient is some form of phosphorous.

Limnology - The scientific study of physical, chemical, meteorological, and biological conditions in fresh waters.

Micro-mhos - A measure of conductivity which is equal to the reciprocal of the ohm and is generally expressed as micromhos per centimeter (cm).

Oligotrophic - Deficient in plant nutrients but having abundant dissolved oxygen.

Oxygen-Reduction Potential (ORP) - The chemical potential of a given material to release electrons (oxidation), or to receive electrons (reduction).

Pacific Maritime Climate - A climate affected by the Pacific Ocean.

Paleocene - The earliest epoch of the Tertiary period of geologic time, approximately 65 million years ago.

Phytoplankton - Minute plants that live unattached in a body of water.

Platinum-Cobalt Unit (P-C) - A measure of water color.

Pleistocene - The earliest epoch of the Quaternary period of geology, beginning approximately 2 million years ago. The most recent epoch of geologic time.

Population - A group of individuals of a single species.

Productivity - A measure of the amount of energy or material formed by an individual, population, or community in a specific time period.

Race - A morphologically distinct group of animals within a species.

Resident - Fish which live their entire life cycle, including spawning, within a small segment of a lake or stream.

Self-Supplied Industry - An industry which supplies its own water, as opposed to one which obtains its water from a municipal system.

Seral - A series of stages or "seres" that follow one another in an ecological succession.

Sorption - The process of taking up and holding by absorption or adsorption.

Species - A group of animals which are capable of or have the potential to interbreed and produce viable offspring.

Species diversity - A measurement of the number of species and the number of individuals within each species for a given area. A higher value indicates more diversity.

Specific Conductivity - A measure of the ability of a cube of a substance one centimeter on a side to pass or transmit energy.

Succession - The replacement of one kind of community by another kind.

Synthesize - To combine or produce; also, a deductive reasoning.

Terminal Moraine - An accumulation of earth and stones which is carried and finally deposited by a glacier at its maximum advance.

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